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American and Other Machinery Abroad.—X.

[Editorial Correspondence.]

SOME PECULIARITIES.

French industrial conditions are somewhat peculiar in many respects, and there are those, apparently well qualified to judge of the matter, who declare that France is making almost no headway whatever in the direction of modern manufacturing methods, at least so far as engineering establishments are concerned. Such statements are, I think, however, in the nature of expressions of impatience at the slow progress being made compared with what it ought to be and with what is being done elsewhere; for it is very apparent that some progress is being made, and, so far as can be judged, this progress will be at an accelerated rate as the knowledge of improved methods becomes more and more disseminated.

FRENCH ARMORIES.

For a good many years France has possessed a means of advancement in shop practice, which she has failed to make use of by reason of what seems to be little else than sheer stupidity.

Every American knows what a commanding influence upon our mechanical development has been exerted by our armories. Mechanics have been freely admitted to them for the purpose of studying the methods there pursued, and by the ebb and flow of tool makers and other mechanics between our armories and other workshops an incalculable influence in the direction of good tool-making, and good work generally, has been exerted.

There can be little doubt that this educational influence, as a factor in the development of our present national strength, has been far more important than the mere production of all the arms turned out by our armories; but France, though for many years she has had armories, in which good work has been and still is done, has, by pursuing a policy directly the opposite of our own, managed to avoid receiving any benefit from them whatever in the way of a general dissemination of mechanical knowledge and manipulative skill. When it is considered that the armory at St. Etienne has at times employed as many as 12,000 men, this complete avoidance of the spread of mechanical education from it seems almost impossible; but official stupidity has been equal to the task.

The above named armory is in the interior, where there are few, if any, other industrial establishments, and where, if men leave the armory, it may be by no means easy for them to obtain other employment in a similar line of work. They are therefore glad to do what the Government requires; i. e., on entering the armory each man is enlisted for fifty-five years (formerly sixty), and this is, of course, equivalent to an enlistment for life. If there is any exception to this rule, it is in the case of laborers or helpers only, and the utmost pains are taken to see that as few men as possible are permitted to know all the mechanical operations involved in the manufacture of firearms.

At Puteaux, which is one of the suburbs of Paris, there is an armory workshop where they make machine tools for the Government. About 1,500 men are usually employed, and an exception to the general rule is made there, partly because it is far more difficult, so near Paris, to get men to agree to a life sentence, and partly because no arms are made at Puteaux, and the mere making of tools is not considered to be quite so important a state secret. Visitors are as rigidly excluded at Puteaux, however, and Mr. F. G. Kreutzberger, who was born in France, learned the trade of machinist and draftsman here, afterward went to America, and, at the Remington armory, gained the knowledge and experience which enabled him to organize, construct and for many years superintend the Puteaux factory, told me he would not, now that he has retired, be permitted to visit it. M. Mandon, who was for four years a draftsman at Puteaux, informed me that he would not be allowed to visit the place, now that he is no longer employed there; but when in America, some years since, he applied for permission to go through the Springfield armory, it was unhesitatingly granted, and he was permitted to wander at will about the place and pick up and examine such pieces of work as he felt inclined to particularly inspect. He informs me that, supposing anyone should be able to get so far in a French armory, he would be certain to be arrested as a spy, and to have considerable trouble in clearing himself.

And the most absurd feature of all this is found in the fact that the whole business of small arms manufacture in France has been borrowed from America. Mr. Kreutzberger brought here in 1855 the knowledge of the art as then practised at Remington's, and about fifteen years ago a Commission, appointed for the purpose by the French Government, went to America especially to study our methods of arms manufacture. Their study resulted in the purchase of a good many American tools, which have been carefully secluded from the public gaze, and some of them copied, at Puteaux.

It is thus seen to be very probable that the French armories contain nothing not to be seen elsewhere; for, in fact, most if not all the small arms factories in Europe have been modelled on the same plan, as a result of study of American methods. Thus France keeps from no possible enemy knowledge that would be useful to him, but merely deprives herself of the greatest benefit of her armories.

BICYCLES AND MOTOR CARRIAGES.

The manufacture of bicycles has done much to advance French shop practice, however, and that of motor carriages seems likely to do still more. M. Clement, who is the largest cycle manufacturer in France (employing 475 workmen), has a good deal of American machinery in his factory, and is now building, on the bank of the Seine, what will be the finest factory in France, if not in all Europe. It will have all the latest and newest features of factory equipment, and considerable additional American machinery will be installed, M. Clement being apparently a firm believer in our system of manfacturing and in our tools for doing it.

The motor carriage is plainly in sight in Paris; one frequently sees them in the street, and there are something like thirteen important concerns that are building them, besides numerous smaller ones. At the works of De Dion et Bouton, in Puteaux, they are building a small tricycle

driven by a motor, are crowded with orders for them, and are enlarging their works and preparing to build larger carriages and omnibuses. Much American machinery is used there also, and still more will be. In fact, this industry will probably not only make a considerable market for American tools, but will, without doubt, have that general educating influence which the French armories ought long ago to have exerted; and this should result in considerable business for American tool-builders.

SOME SPECIAL FRENCH TOOLS.

Those who attended the Chicago exhibition will not be apt to forget the exhibit of French machine tools there. To say that they were very poor, according to our standards in such matters, is to state the case mildly. Such tools are produced mainly in the North of France, near the Belgian frontier, and it is said they have not been changed in design for very many years, but are built as cheaply as possible for a market which is nearly worldwide. They do not go much into real engineering establishments or machine shops, but mainly into the hands of smiths and small concerns, who may have a little drilling or turning to do incidentally, and do not care, or are not able, to pay the price of a really good tool.

Some American tools have recently been installed for the more economical production of these peculiar tools; but it is not anticipated that any change in the design of the product is contemplated. Thus American tools have found at least some appreciation where it would perhaps be least expected.

DIVERSITY OF PRACTICE—GOVERNMENT REQUIREMENTS.

An engineering workshop in France is generally supposed to be prepared to undertake any kind of a job that may be offered, and the proprietor of such an establishment would be apt to feel himself disgraced if he felt compelled to decline an order for lack of facilities for executing it. The same principle applies to the practice of engineers. An engineer in France is generally supposed to be able to give expert advice in any branch of engineering. For him to confess that bicycle manufacture, for instance, is a specialty with which he has no practical acquaintance would be, in a sense, equivalent to a confession of incompetance. He is supposed to be able to direct any kind of industrial operation in any way related to an engineering establishment. It is much the same in Italy and elsewhere, and it is safe to say that, so long as this remains true, the highest development of engineering skill will be impossible. In the shops it leads to a diversity of work, which is fatal to the best results, either in point of perfection of production or economy of production. In the matter of steam pumps, for instance, there is scarcely an engineering workshop in the Republic which does not occasionally build a steam pump; but there is not one that makes a business of steam pump manufacturing, and there seems, indeed, to be far less tendency to take up any specialty and fit up for manufacturing that specialty in a proper manner. Whether from this cause or some other, the French steam pump is, to American eyes at least, a frightfully ugly piece of construction, and the best American pumps make their way here partly because they are very much neater and handsomer in appearance and are recognized to be so by the French engineers themselves. A large proportion of the smaller pumps sold here are made in Brooklyn by the Worthington company, but are sold by the French Worthington company—a separate company organized for the French business, mainly, perhaps, because it is impossible for a foreign company to do business with municipalities here or to sell to the French Admiralty. All the water-works pumping engines and all the pumps supplied for naval vessels are therefore made in France, and so closely is this matter looked after that, as Mr. Bagshawe, the manager of the Worthington Company here, informs me, receipts for the castings entering into the construction of an admiralty pump must be produced to prove their French origin, and every part of such a pump must, before it goes into service, bear the stamp of a Naval officer who has satisfied himself that that part was actually made in France.

Some time ago a contract of considerable importance was given out, and it was divided among a number of French pump builders. Most of them were behind with deliveries, and they bought Worthington pumps from stock and installed them temporarily, taking them out and replacing them with their own when the latter were completed. Some Babcock & Wilcox boilers were contracted for. All parts of them could be made in France, but if the manifolds were made here they must be cast, while if made in the Glasgow works, they could be of pressed steel; the special machinery for making them of that material being in existence nowhere else. The engineers wanted the pressed-steel manifolds, but for some time no way was perceived by which they could be obtained. Finally, after much cogitation, it was decided that steel sheets made in France should be prepared, properly marked for identification, sent over to Glasgow to be pressed into shape and returned; and this was actually done.

In practice, no water-meters can be made elsewhere than in Paris; and not only within the city of Paris, but within the fortifications. The law requires this for the city, and practically, owing to the system of inspection and the facilities for testing which exist nowhere else in the Republic, no meters can be made elsewhere in France than within the fortifications of Paris.

GOOD FRENCH WORK.

The manufacture of water-meters forms an important part of the business of Bariquand & Marre, an establishment not infrequently referred to as "the Brown & Sharpe of France." The contrast between its shop and that of its American prototype is a very strong one; but they do very good work, both in tool-building and in manufacturing specialties. They do a good deal of milling, and use vertical machines of their own make almost exclusively. All the smaller slides and similar parts of their machine tools are milled, and the work is well done, so far as I could judge from a casual inspection; but it is done slowly and with cutters having such fine teeth that they seem more like files than milling cutters. The teeth are cut in them by what are called copying machines, using very small stem cutters, and the cutter is guided by a template over which an arm is moved by the hand of the attendant. They are sharpened by a machine of the same general construction; the original form of the cutter, and its preservation of form as well, depending upon the template and the accuracy with which it is followed by the machines in milling the teeth and in subsequently grinding them.

The gentleman who accompanied us about the works informed us that they believed in vertical spindle milling and practiced it exclusively, but that in America the practice is to use horizontal spindles. The latter would do more work, but would not do it so well.

I had previously had the impression that we did a good deal of vertical spindle milling in America also, and that whether the vertical or the horizontal spindle method would do most or better work in any given case depended very much upon circumstances.

Bench-measuring and other tools of precision are made by this firm also, and at the time of my visit they were making a set of standards for the newly recommended French or metric system of standard screws. Their method of securing correct pitch for these will be touched upon later.

A good many women are employed in screw making and similar work; some of them on milling machines, and very little automatic machinery is used—in fact, I do not remember to have seen one such machine. We had some conversation with M. Bariquand, who is himself an engineer and a very agreeable gentleman, and found him to be in a very happy frame of mind, so far as business is concerned. He informed my friend, whom he took to be an American, but who is really an Englishman, that he recognized but one competitor, and that is Brown & Sharpe; no other American concern was apparently worth consideration, in his eyes,

and the English were simply dead—not in it at all. It is thus evident that M. Bariquand dwells in an Arcadia, and his peace of mind is certainly much to be envied. But other American firms are certainly selling lathes and milling machines here. They make hair-clippers, much the same as those manufactured by B. & S.; but more of the American clippers are sold in and from Paris than of the French manufacture, and if one goes into a Paris barber shop and inquires, he will probably be told that they have used both the French and the American clippers, that the latter are somewhat higher in price, but are better and will last about three years before requiring a new plate, while the French ones will last only about one year.

A VARIANT IN MACHINERY SELLING.

Most of the machine sales agents I have met, both in Great Britain and here on the Continent, greatly prefer to have the exclusive agency for a given machine and to so arrange that that machine can be obtained of no one else. Here in Paris I find M. Adolphe Jannsens taking the opposite view. M. Jannsens was for a long time connected with Smith & Coventry, of Manchester, and still handles their tools, though not, as formerly, to the exclusion of others. His position is that he can best serve the interests of all concerned by consulting, primarily, the interests of his clientele, and putting in, if possible, the best machine for the given purpose, keeping himself free to choose from the product of as many builders as possible. Undoubtedly this plan has its advantages, especially where the dealer is also an engineer, competent to give advice, and where, also, he is honest enough and far-seeing enough to enable him to select and advocate the machine which, in his opinion, is actually best for a given purpose, regardless of differences in discounts and other circumstances not affecting the qualities or adaptabilities of machines.

That American machines generally do not suffer at Mr. Jannsen's hands is abundantly shown by his records of orders filled, which I had the privilege of inspecting, and which show that very many American machines have been introduced by him, not only in France, but in Belgium and Switzerland as well, and I noted that some business was done in Germany, which is rather unusual for a French house.

F. J. M.

Paris, June 16th.

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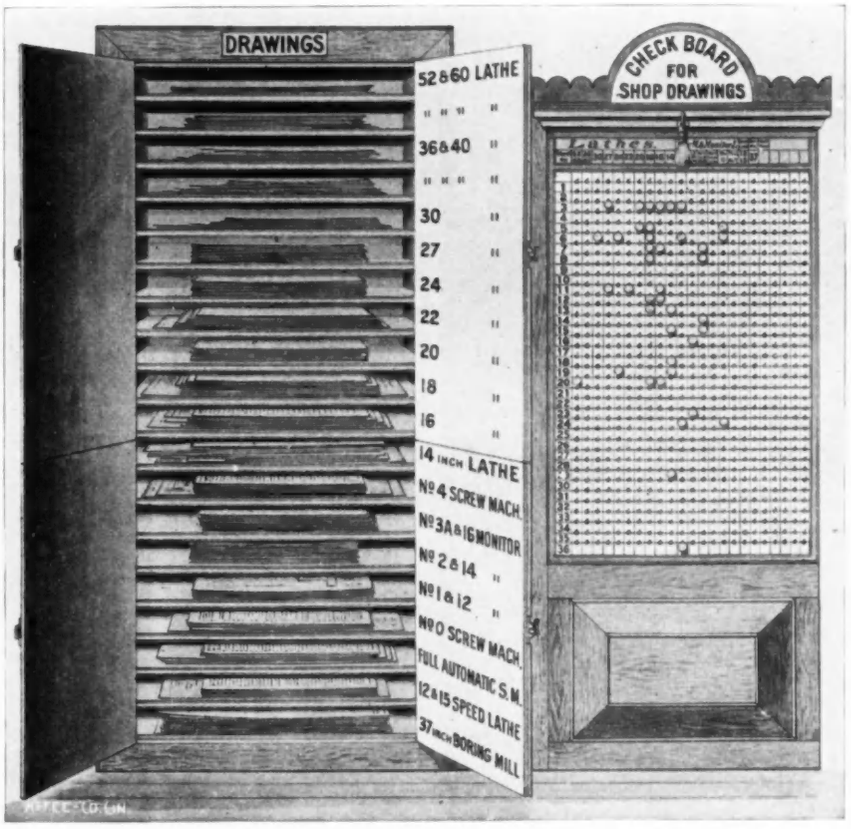
System of Shop Drawings.

The accompanying illustration shows a new system of shop drawings as used by The Davis & Egan Machine Tool Company, of Cincinnati, O.

The drawings are all made to one or the other of two standard sizes, 19 x 13 and 19 x 26. They are mounted on galvanized iron, having the ends and sides turned over, so as to preserve the edges and lend additional stiffness. They are placed in the drawing cupboard, shown in the cut. Directly opposite each shelf, on the door, appears the name of the machines which the drawings represent.

Accompanying each set of drawings is an index sheet, giving the number of each detail sheet; and, duplicates of this index are hung in convenient places throughout the works.

In combination with the cupboard is a check-board, shown at the right. At the top of this check-board is the name and size of each machine, for which there are drawings in the cupboard. At the right-hand side of the check-board appear the numbers of the detail drawings.



SYSTEM OF FILING SHOP DRAWINGS.

When a workman in any department wants a drawing, he consults his index and obtains the number of the drawing wanted. He then rings for a bell-boy. The boy goes to the main tool room where the drawings are kept, secures the drawing, and gives the workman's check to the party in charge. The check is then hung directly under the name of the machine and opposite the number of the detail sheet, so that by a glance at the check-board, you can readily see the number of the drawings in use in the works, and just what workmen have them.

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It is but ten years this month of July since the first electric railway commercially successful was started in Richmond, Va.

The Brag of the Census.

After all is said, the tallest American bragging is done by the United States census. There is, in fact, no need for any other. There is cause for just pride and satisfaction in every one of the following items: (1) In population we are 22,000,000 greater than Germany and 34,000,000 greater than Great Britain, or than France. (2) Notwithstanding our great excess of population, the number of persons actually engaged in manufactures is 3,837,000 less than in the other manufacturing countries. (3) And yet while the number employed in manufactures is less, the value of our annual product is much greater. Ours are $7,000,000,000 a year; while the total values of the combined manufactures of Great Britain are $4,100,000,000; of Germany, $2,915,000,000; France, $2,246,000,000; Russia, $1,815,000,000; Austria-Hungary, $1,265,000,000; Italy, $605,000,000; Belgium, $510,000,000; Spain, $425,000,000, and Switzerland, $160,000,000. (4) The average product per individual employed is, in the United States, $1,888; Great Britain, $790; France, Belgium and Germany, $545; Switzerland, $433; Russia, $381, and Italy, $265. (5) The average wages paid are in the United States, $348; Great Britain, $204; France, $175; Belgium, $165; Germany, $155; Switzerland and Austria-Hungary, $150, and Spain and Russia, $120. (6) The steam horse-powers in the United States are 18,000,000; Great Britain, 12,000,000; Germany, 9,000,000;

France, 5,000,000; Austria-Hungary and Russia, 2,500,000 each, and Belgium, 1,000,000.

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A Pocket Recorder for Tests of Materials.*

BY GUS C. HENNING, NEW YORK CITY.

The instrument which I am about to describe is one designed to be used on any and all machines which have a running poise weight, without causing delay for adjustment, the results at the same time being reliable, and such that they can be at once interpreted. Therefore the instrument must be flexible in its application, equally handy for large and small test pieces, whether round, square or of other section, and the scale of diagram

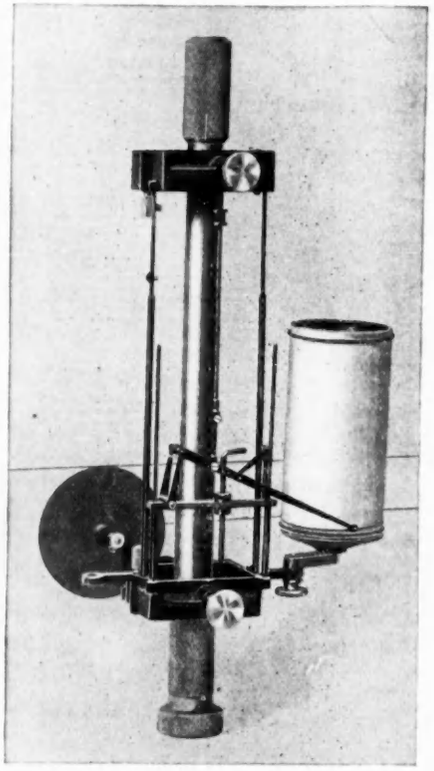

Fig. 1. A POCKET RECORDER.

must be at once adjustable to the work to be done. It must, in fact, be universally applicable as a steam engine indicator, and be so easy of application and interpretation that any intelligent person can use it without a long course of instruction.

It must be portable and compact, requiring no extra precautions in adjustment or regulation; and without having the accuracy of an instrument of precision, must be perfectly reliable, and as correct as the other apparatus in connection with which it is used. It must cover a wide range of work of short and long, large and small test-pieces, such as are found in general use, and must be applicable to hard and soft materials as well.

* Abstract of a paper presented at the Hartford meeting (May, 1897) of the American Society of Mechanical Engineers.

Moreover, it should give a complete record from beginning to end of test, and the more important elements on an enlarged, and the lesser on a natural scale. Thus, while elongations within the elastic limit are very minute and must be recorded on a magnified scale which is reliable, changes of length beyond this critical point are very large, rapid and variable; hence measurement with a steel scale suffices, and the record on a diagram may be on actual scale. This change of scale must, however, be positive, controllable, and at a fixed instant or point, and must not introduce errors in the record.

In case of materials of slight extensibility, however, the entire record should

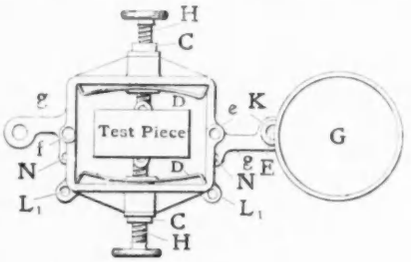

Fig. 2 *American Machinist*

be on one scale from beginning to end, and the instrument should be so attached that it does not nick or injure the material so as to affect its point of rupture or strength.

As materials under test change shape rapidly and constantly, the instrument must be so designed that this variation does not introduce errors by slipping or tilting or otherwise.

Means must be readily applicable which will check the accuracy of the instrument at all times. If an instrument fulfilling all of these conditions can really be constructed at a reasonable price, it seems that its general introduction in the kit of every engineer who has to deal with the strength of materials would be an easy task, and once its usefulness is demonstrated it would become a necessary adjunct in all work, especially as it does not increase the cost.

As materials are generally tested at the present time, there is no lasting record of the qualities that are claimed to have been found, and a test cannot be repeated upon the same piece of material. Moreover it is well known that many properties of materials cannot be determined except by an autographic stress-strain diagram. The curves obtained vary according to the treatment which the material has been subjected to, and annealing or straining produces such marked results that an autographic record would at once indicate how the material has been treated. Hardening, cold rolling, tempering and other processes are made apparent by the characteristic features of the curves.

With the use of such a recorder, it would become instantly apparent whether material had been previously intentionally strained to raise the elastic limit, as is well known to have been done. Overheating of material would be clearly indicated by the change in the curve, and the general uniformity of any lot of material could be readily determined.

When it is further stated that the apparatus is equally applicable for compression tests and that it can be used equally well in a horizontal or vertical position, its general usefulness will become apparent.

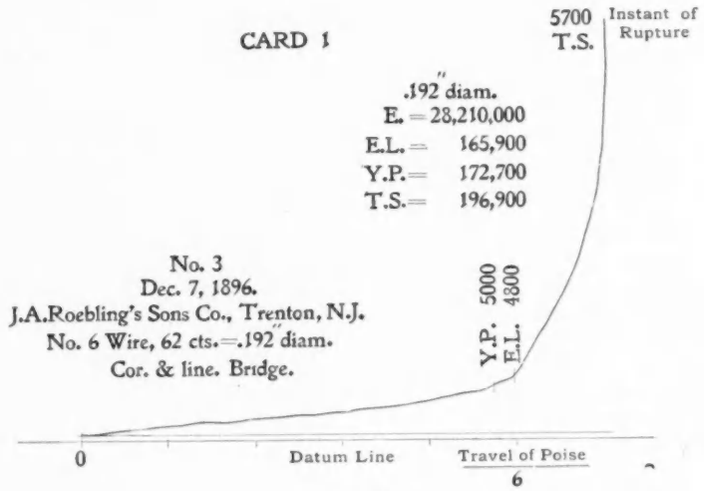

Fig. 3 *American Machinist*

In every case the elastic limit and yield point, as well as maximum load, and load at breaking point, are clearly defined and the question of where or what are elastic limit and yield point is at once settled. The curves also allow the accurate determination of the (E) modulus of elasticity which is a most valuable factor, but rarely determined, because very difficult to obtain with any degree of precision; also requiring great care, much patience, time and a careful observer.

There is another use to which this instrument can be put; it is to act as a check or controller upon the actions of the per-

son charged with operating the testing machine, who is generally sufficiently familiar with the material made at his works to be able to "jockey" the machine so that the material apparently gives results which fill specification requirement.

The apparatus (Fig. 1) consists of two hinged symmetrical frames *A* and *B* (Fig. 2) which surround the test-piece and are attached to it automatically at the standard gage length. The frames are hinged by taper pins and plugs *e* and *f* and are provided at the center of opposite sides with spring cushioned bushes *C;* these bushes are nicely fitted to the holes in the frames, and are allowed to move forward and back by the play of the springs *D*. Through these bushes, screws *H*, with hardened ends shaped like knife-edges, pass. The frames are provided, one with

CARD 2

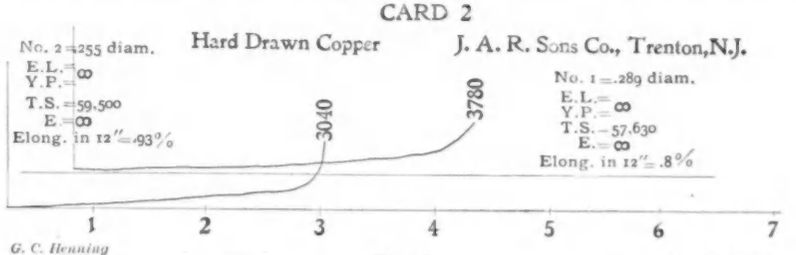

Fig. 4

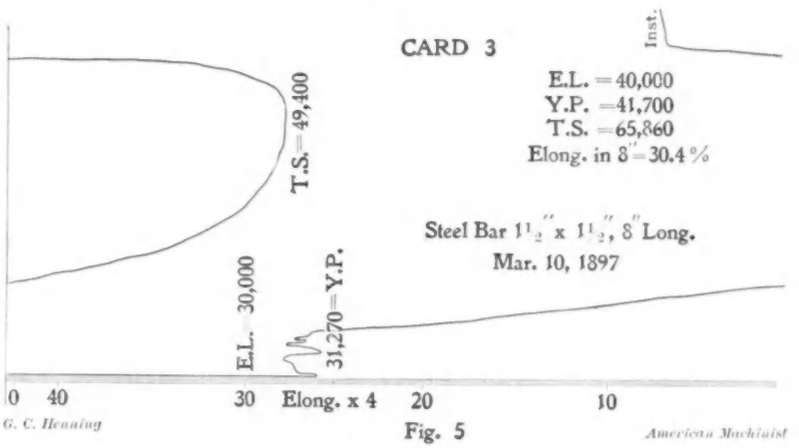

Fig. 5

rods N, the other with tubes *N* fitting the latter, so that one frame steadies the other (Fig. 3). These rods are of proper length to keep the frames a certain distance apart in order that the knife-edge screws bear on the test-piece at fixed lengths. These rods allow ready motion of either frame in the direction of axis of test-piece. The frame *A* has two arms *g*, one on either side, for carrying the wheel *F* and drum *G*, either on the right or the left (Fig. 4). The wheel *F* is, however, connected to *g* by the link *E* and screw *K*, so that it can swing to and from the marking point at will. This wheel *F* revolves freely about the stud *I* carried by *E*.

The frame *A* carries another most important member, a parallel motion, such as is found on any steam-engine indicator; this mechanism rests on a bar *R*, carrying two tubes *L*, which slide nicely on two rods L_1 screwed into the frame *A* at *a*, and is operated by a connecting rod "*d*" secured to frame *B* at "*b*."

This bar also carries on its upper side a hooked rod *c* which is adjustable and which hooks over one of the levers of the parallel motion when it has reached any desired position. The marking point of this moton touches the paper wrapped around the drum *G;* the latter is revolved by a string *S* lapped around it, one end being tied to the poise weight of the beam, the other carrying a small balance weight. The string, of course, passes over conveniently located pulleys, to be properly guided.

APPLICATION.

The screws *H* are advanced so that their ends are separated by a distance equal to the diameter of test-piece less about 5-16 inch; a sheet of paper is wrapped around the drum and held in place by rubber bands or clamps; the frames *A* and *B* are then opened and placed around the test-piece, and *A* is closed, dropping plug *f* into place; this operation holds the instrument in place. Now the upper frame *B* is closed in the same manner. This attaches the instrument on test-piece at the gage length. Now the string is tied to poise and balance weight, is then wrapped around the drum once, the drum is turned slightly so that the pencil of parallel motion bears against the paper, and the instrument is ready for work.

To mark off the scale for load, the poise is advanced, and for every 1,000-pound mark reached on the beam, a mark is made on the paper on the drum. As the tension on the string is always constant, being regulated by the balance weight, the string, being of the stretchless kind, retains an exact length, as is demonstrated by the scales laid off on the diagrams. The line thus drawn on the drum serves as a zero or base line; another is drawn at right angles to it by running the marker up and down.

Now the test can proceed, and the only precaution necessary is to keep the weighing beam exactly at its central or floating position throughout the test.

When the material has stretched somewhat, a sudden change of stretch will be observed, very soon followed by a much more rapid change. The first change indicates the "elastic limit"; the second, the "yield point." Supposing that the material is a hard one, with very little deformation before rupture, the whole curve is drawn out on the magnified scale. Should the material be iron, steel, copper, or other highly extensible material, then to record the stretch to the breaking point would require a very long drum; in the case of a rod of steel 8 inches long with 30 per cent. stretch this would require a drum 12 inches long and more, and a parallel motion which would be very large, clumsy and expensive. As a result the apparatus would be unwieldy and almost impossible to use. Moreover, the elongation up to yield point alone need not be determined with great accuracy, and as the permanent elongation is never measured closer than is possible with a steel scale, it need not be recorded with greater nicety. Now, as the stretch of all structural material up to the yield point is always less than 1-10 inch on an 8-inch length, the hooked rod *C* is so adjusted that, at the instant of 1-10 inch stretch, it arrests the parallel motion, causing it to slide as a unit on the rods *L*. As the parallel motion multiplies five times, this stretch will be recorded as ½ inch on the paper. After this instant all further stretch is recorded, on actual or natural scale. Hence, to measure the total elongation of rupture, all that is necessary is to measure the elongation as shown on the record and deduct 4-10 inch from it. This arrangement makes it possible to record all tests on a drum 4 inches high.

The drum chosen in this apparatus has a diameter of about 2 inches, or a length of circumference of 6½ inches. If a longer record is desirable the drum is allowed to revolve as often as necessary or a larger drum is used, the curves then being continuous around the drum.

As the weighing beams on testing machines are generally 50 inches long, this would require eight revolutions of drum for 100,000 pounds load; however, in ordinary testing, loads do not usually exceed 50,000 pounds, corresponding to a travel of poise of about 25 inches, or four revolutions of a 2-inch drum. As this is still too large, the motion is reduced by a set of very light pulleys, over which the string runs a proper number of times to obtain the desired length of diagram.

When the test-piece breaks, the instru-

ment separates into two parts, thereby preventing any injury to it. The rods N_1 and L_1 simply draw out of the tubes N and L, while the parallel motion remains suspended from the upper frame by the connecting rod. The parts are all so light that even considerable shock will not injure them; the knife-edges also allow a small amount of slip on the test-piece at instant of rupture, and this also protects the instrument.

It is, however, important to take one precaution to avoid injury at instant of rupture, viz.: the gripping wedges must be blocked, so that they cannot fly out of place and allow the parts of the test-piece to do likewise.

It will be noticed that the instrument is exceedingly compact; that the parallel motion is immediately adjacent to the test-piece, and that hence distortion of the frame will produce only a minimum error. The parallel motion also is so light, and requires such a very slight force to move it, that this cannot produce errors, especially as this force is constant for all positions of the marking point.

Should it be desirable to use the instrument on longer test-pieces, such as wire, usually tested in 12-inch lengths, it simply becomes necessary to substitute a longer connecting rod to actuate the parallel motion.

For recording compression tests it is only necessary to substitute a shorter connecting rod, so that the marking point will stand at the top of the drum at the beginning of the test, instead of at the bottom, as shown.

Again, should it be desirable to make alternating compression and tension tests, it only becomes necessary to use a connecting rod which will set the marking point at the middle of the drum instead of either the top or bottom. No other preparations or precautions are necessary.

Card 1 gives the record of test of a No. 6 wire, in which the travel of the poise on the beam of a 10,000 pound machine is reduced to 1/6; the elongation to rupture being multiplied by 5.

Card 2 gives the record of two hard-drawn copper wires, Nos. 1 and 2, 12-inch length, extension to rupture multiplied by 5.

Card 3 is of a piece of structural steel 1½ x ½ inch, 8 inches long, elongation multiplied by 4 up to a length of .095 inch, after that record is natural scale, after point "*a*" to rupture.

It will be seen that the cards have the scale of weights marked on them, and the uniformity of divisions will be readily seen.

The accuracy of records of elongations can be established by attaching the instrument to a micrometer and then obtaining a record due to operation of the latter. If the record thus made is proportional throughout its length to the readings of micrometer, then the instrument is also correct; and as this is an investigation that should be made with each instrument to determine its rate of multiplication, it goes without saying that corrections can be readily applied to the record; further consideration thereof can be dismissed.

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The Place of Our Destination—III.

Editor American Machinist:

As I am writing, this first day of June, a race of automotors or horseless carriages is to begin, starting from the Crystal Palace and running to Birmingham and back, a distance of about 230 miles—varying as to choice of roads. As to the result, likely cable reports will reach the readers of the "American Machinist" long before this, and I might as well deliver my sermon from what I have seen as to await results. Some time last year "The Engineer" offered some 1,100 guineas in prizes for different classes of automotors—one for best, to carry four or more persons, besides the driver; for one to carry two or three persons; one to carry not more than a ton of goods; one to carry five hundredweight; and the fifth prize to be for either burning heavy oil.

I have omitted a lot of detail, and wish to emphasize the features that are to have a bearing on the result: 1st, the distance run, without stopping from any cause whatever; 2d, design; 3d, safety; 4th, simplicity, durability, accessibility, facility of repairs, absence of smells and of excessive vibration; 5th, time in starting; 6th, speed up to ten miles an hour, and hill-climbing; 7th, steering and brakes; 8th, weight; 9th, cost and, to a limited extent, cost of working; 10th, general efficiency. I have abreviated these requirements, though No. 6 is complete, and is the clause that will most forcibly strike our people who are interested in the horseless carriages.

The entries had to be in last March, with a forfeit for non-appearance, and I believe a large number of entries were made, but only seven carriages have put in an appearance. These seven show seven varieties, but I should certainly think the number must fall far short of what could have been reasonably expected, and I am sure the whole lot fall far short of what the future horseless carriage will be. The van for parcels, it seems to me, more nearly fills the requirements for a van than the pleasure carriages fill their place. The van is a steam machine, using oil for fuel—a traction engine adapted to light service; vertical 25 horse-power water-tube boiler for 250 pounds pressure, and engine double tandem compound with piston valves, with arrangement to admit steam to low-pressure cylinders for hill-climbing. The driving gear has "Jack in the box" compensating gear, which, I may say for the benefit of the younger readers, is an old English invention which enables both driving wheels to drive equally whether the van is running straight ahead or turning a corner. It is a device used on all traction engines, but many of the light automotors dispense with it, one or both of the driving wheels slipping when turning from a straight line.

Where a single front wheel is not used, all the front wheels turn independently, rather than the front axle turning on a king-bolt—one like front bicycle wheels, others approaching, but none so nearly correct as this shown by sketch Fig. 1; the object of the arrangement being to prevent shocks on the steersman when striking an obstacle. It was a wagon constructed on this plan that led John Coffin to make the characteristic remark, "That is a pretty good new wagon; I wonder what kind of an old one it will be."

A second exhibit was a storage battery in cycle machine, made to look very light, which no doubt was simply a matter of looks, for it must be heavy altogether, as they claim to have enough electricity in store for 40 or 50 miles' journey. The front wheel was a large bicycle wheel, very frail, and labored hard to steer the machine, except when under good headway. So far as a pleasure carriage, it was one of two that promised some pleasure in riding. The third was a storage-battery machine also. The four others were of the gasoline or oil-engine variety, and while the gasoline engine may be said to have opened the way to the horseless carriage, and while it cannot be denied that they go, I very much doubt that the machines, as now made, will be the machines of the future, even if the internal-combustion engine holds its place—certainly not in England, and perhaps I cannot better explain why I make the distinction than to refer to the bicycle history.

The velocipede with pedals made its first appearance in France in 1867; it had a certain run and practically died out in a few years. In America it swept the country like a whirlwind and died out in a few months; but in England it grew slowly, and finally grew, without a relapse, into the bicycle. This was due to two causes—the good roads and the willingness of the English to go at a reasonable pace. And so I look forward to the English being the people to produce the horseless vehicle. They have the good roads, and they not only have the disposition to go at a reasonable pace, but the law limits them to 12 miles an hour, which is fast enough to travel at if one wants to travel for pleasure, and fast enough for a grocer's wagon. Limiting the speed will enable a moderate-size machine to do the work. The machinery will not need to be so light as to be dangerous, nor so heavy as to make a wagon-load of itself.

Some of even the gasoline-driven carriages contained a wagon box full of machinery. One was set crossways, and

used a worm gear to reduce speed, and another had a fly-wheel fearfully out of balance. Nearly all of them seemed to shake like a mowing machine and make as much noise, and as they had to keep up speed when the carriage was at rest, the noise and odor were certainly very objectionable. All use small wheels and aim to make the carriages very low. Both, I believe, will be changed.

While time and trial have shown that 26 or 28 inches is best for bicycles and trotting sulkies, the condition of the track for carriages will always be rougher, and larger wheels will go the easier; and as it is known that a high locomotive rides easier than a low one, and the top of a 'bus is freer from jar and more agreeable than inside, so I believe the carriages will be set higher, notwithstanding the extra trouble in mounting; for in traveling for pleasure one wants to get rid of the annoyances and see about him. I know full well the idea with us is "Get there," and

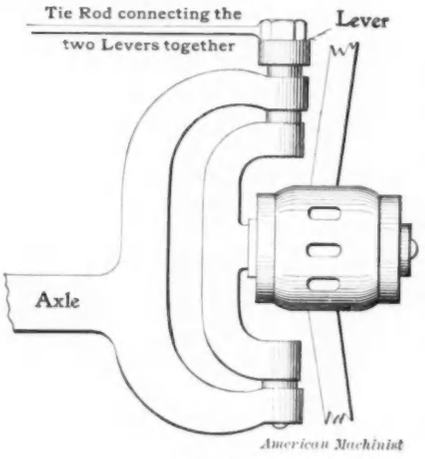

Fig. 1

STEERING GEAR OF AUTOCAR.

that the people who will first buy horseless carriages will be the men that have the "get up and get" in them, and it is this very fact that will defer the perfecting of the automotor with us. I am writing this with the full consciousness that the French have the oil-engine wagons running by the hundred; that a lot of machines are being experimented with in America, and that stock companies are being promoted to the hundred millions of dollars capital, in various countries; still, if the Crystal Palace machines are the best that have been done, there is plenty of room to start over again, and the man who arrives at ultimate success will do it some other way.

As success will also depend on good roads, I will take occasion to ventilate one of my hobbies—roads and streets—and say I believe the fundamental reason why the English have good roads and we poor, is simply because their roads and streets are very narrow and ours very wide. In the case of their roads—only a rod or a rod and a half wide, with not over 12 feet of road bed—they simply have to make them good, or they cannot get along; while with us, if the road bed is not passable, we turn out on the side. Theirs are so narrow that they can afford to make them good; ours, so wide we cannot. And it it so with our streets in the residence districts and provincial cities; all the road beds in the streets are two, three or more times wider than there is any earthly use for. Our people will not do with any less, and to spend the money to make them good would mean bankruptcy. I am led to refer to this, because good roads are pertinent to the subject of horseless carriages, and I have had two or three occasions to see holes morticed through the street pavements here in London, and even the narrowest ones have 12 inches of solid concrete, whether carpeted (as John Richards calls it) with stone, wood blocks or asphalt—all of which are used.

It would hardly seem necessary to point out the fact that the beauty of a suburban street is entirely due to trees and width and character of the lawns, and not to the roadway; and yet the proposition to narrow the road bed in any of our streets to the actual necessities of the traffic will stamp a man as a crank or an idiot.

JOHN E. SWEET.

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Safety Valve Practice.

BY W. H. BOOTH.

All sorts of opinions prevail on the subject of safety valves. No valve can pass the quantity of steam which will flow through a pipe having a diameter equal to the nominal diameter of the valve, unless such valve lifts from its seat to the extent of one-fourth its diameter. Certain old rules for safety valves were based on grate area alone and took no notice whatever of pressure.

Now, pressure is a very important factor—so important, indeed, that, had the progress of boiler practice been in the direction of lower pressures, I much fear we should have seen many explosions as a result of insufficient area of valve. Fortunately pressures rose, and valves big enough for 20 pounds pressure were too big for a pressure of 40 pounds.

A committee on safety valves once sat over here, and I remember that they issued a very valuable report, which was published somewhere about the year 1870 or 1872, if I remember rightly. The committee went thoroughly into the question, and amongst other matters they experimented upon the flow of steam from a vessel at one pressure to one at a lower pressure. There are some old notes on my bookshelf, which, if I can find, I will add to this. The committee showed that, practically, the weight of steam discharged by an orifice is proportional to the pressure, and they argued that as fuel evaporates the same weight of water no matter at what pressure, therefore the boiler with biggest pressure need only have smaller safety valves than lower pressure boilers, and therefore the rule basing diameter of safety valve on grate area alone was misleading. They experimented also on the lift of a safety valve, and found it to be about one thirty-second of an inch—an amount quite paltry beside the proper lift of one-fourth the diameter.

In proportioning a safety valve, we ought, then, to take into account the probable maximum coal consumption on a maximum grate area, and then proportion the valve to the pressure. As boilers grow old there is a tendency for their safety valves to continue with them, and in such cases, of course, as the boiler becomes a low-pressure boiler, its safety valve becomes too small for its fresh conditions, and this is a point that purchasers of second-hand boilers ought to be on their guard about, or they will find that pressures tend to get unduly high before the safety valve can relieve them.

Since writing the foregoing, I have found my old notes, and see that reference is made to the Committee on Safety Valves and the report in "Engineering" of the year 1874. What belongs to the report and what is extraneous thereto, I cannot say. I merely quote the substance of my notes, which I see were written down sixteen years ago.

Rankine states there is no difference in the flow of steam when the external pressure is reduced 58 per cent. For absolute pressures, P, not less than 25.37 pounds, or 10.7 pounds above atmosphere; v = velocity in feet per second; h = hight of a column of steam of pressure p = density P.

$$\text{Then } V = 3.5953 \sqrt{h}$$

Thus at a pressure 25.37, $v = 863$, $h = 57570$. To calculate h, $\log. h = 4.67735 + .059 \log. p$.

A square-edged orifice discharges $\frac{88}{100}$ of a round-edged orifice, or 14 per cent. less.

The weight of steam discharged from a square-edged orifice per square inch is ¾ pound; the pressure in pounds absolute. Thus at 40 pounds absolute the weight per minute discharged through a hole of 1 square inch area is 30.5 pounds—in symbols,

$$W = \frac{3}{4} P$$

The actual velocity at the orifice is $v \times 1.624$, because expansion of the escaping steam begins before complete discharge, and this seems to account for the fact that reduction of the external pressure does not have much effect in increasing outflow. Three square inches at 30 pounds pressure will discharge 69 pounds of steam per minute. One square inch at 90 pounds pressure will discharge 67 pounds per minute; hence the fallacy of basing safety-valve area on fire grate; for the heat required to produce the 67 pounds of steam from feed water at 100° is only

1 per cent. less than that necessary to produce the 69 pounds of steam at 30 pounds pressure. Assuming a combustion of 20 pounds per square foot per hour, and an evaporation of 9 pounds per pound of coal, we get 180 pounds evaporated per square foot of grate hourly, or 3 pounds per minute. The discharge through 1 square inch being $\frac{3}{4}P$, the area to discharge 1 pound will be $\frac{4}{3}P$, and generally the safety valve area will be $\frac{4G}{P}$ where G is the grate area in square feet.

Calling L = area of discharge ÷ circumference of valve, and by above and the Board of Trade rule of ½ square inch per foot of grate area, or $A = \frac{G}{2}$, we have

$$G = 2\,(D^2 \times .7854) \text{ and}$$

$$A = \frac{4 \times 2\,(D^2 \times .7854)}{P}$$

Therefore L (which is the lift of the valve) $= \frac{1.92\,D}{P}$, or, say, $L = \frac{2\,D}{P}$ for flat-faced valves, and for valves with angles of 45°

$$L = \frac{2.8\,D}{P}$$

From these was deduced formula for spring loading and for proportions of springs.

Where D is diameter of steel in sixteenths of an inch, or the side of square steel, and W = total load on valve,

$$D = \sqrt[3]{\frac{W \times d}{3}} \text{ for round steel, and}$$

$$D = \sqrt[3]{\frac{W \times d}{4.29}} \text{ for square steel,}$$

d being the mean diameter of the spiral spring.

The extension of one circle of a coiled spring (helical) is $E = \frac{d^3 \times W}{D^4 \times c}$, and c=22 and 30 for round and for square steel, respectively. The total extension or compression of a spring is $E\,N$, where N is the number of turns of the helix.

Suppose pressure in boiler must not rise above 2½ per cent., we have

$$L = \frac{2\frac{1}{2}}{100} \text{ of } E\,N. \quad \therefore E\,N = \frac{80 \times D}{P}$$

With an allowance of only 2 per cent. of excess pressure,

$$L = \frac{100\,D}{P}$$

So proportioned, all valves would lift one thirty-sixth of their diameter, and A would become

$$\frac{36\,G}{P} \text{ or } \frac{1.2\,H\,S}{P}$$

where $H\,S$ = heating surface, and $E\,N$ would be 1.11 D, so that for a valve to lift one-fourth of its diameter $A = \frac{4\,G}{P}$ + area of wings, and breadth of face should not exceed 1-12 inch.

It would appear that the Board of Trade rule is only sufficient for pressures not less than 70 pounds.

In the experiments on steam flow, three vessels A, B and C, were connected in series. In A the pressure was 100 pounds, and there was a stop cock to the outlet from C by which the pressure could be regulated, and it was found that with 100 pounds in A the cock could be opened, and the pressure in B and C fell steadily down to 56 pounds in C when it was 81.9 pounds in B. When reduced to 48 pounds in C, it was still 81 pounds in B, and it remained at 81 pounds in B all along down to the pressure of only 18 pounds in C.

Assuming the foregoing to represent good practice, it would appear, therefore, that safety valves had been much too small, and had, in fact, been simply noisy warnings to firemen to cool down. They would not discharge the steam that a boiler would make. Possibly they would discharge all excess when the engine was running; but when the engine was at rest, a valve only gave notice to turn on the feed, close the damper or open the fire door, or take steps generally to check steam production.

The number of coils in a spring is seen to be more than a mere form. A spring has a certain resistance according to its size of wire and its coil circle, and for each coil, will deflect so much per unit of load. Hence, to get more valve opening for an additional pressure of steam than one coil will allow, we must multiply the coils. Thus, say a coil is compressed 1-100 inch for 2 pounds extra pressure, and we require a lift of 6-100 inch, then must we have six coils in the spring. The movement of a helical spring is, in fact, proportional to the number of its coils, inversely proportional to the cube of the wire diameter, and proportional to the fourth power of the mean diameter of the coil—that is, its diameter from center to center of the wire forming the coil.

London, England.

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A Homeopathic Reamer Grinder Wanted.

BY FRANK RICHARDS.

I suppose that Mr. Rothwell's interesting letter on "Chattering Reamers" in the "American Machinist" of March 18th is scarcely to be considered the last word on the subject. In fact, it seems to furnish in itself the necessity for at least a word of explanation. In the reamer which I showed, January 28th, it was the straight reamer for the hole, and not the bevel cutter for the seat, which did the chattering. It was the straight part of the reamer that Mr. Richardson treated lightly with the oil-stone, and thereby cured the trouble so completely; so the non-radial teeth, the irregular spacing and the hook to the cutting faces are wasted inventions, so far as my case is concerned. If the rose bit which Mr. Rothwell shows had not all the improvements which he has given it, there would still be little likelihood of its chattering. If the tit which he shows on the end fitted the hole it would only be possible for the bit to chatter on account of the shank or spindle vibrating endwise, and the steady and constantly unyielding pressure of the feed would prevent that. The three improvemnts or changes noticed on Mr. Rothwell's bit would neither of them necessarily cure, or help to cure, the chattering if other conditions should invite it.

And chattering always occurs by invitation. It is not accidental, but is always produced by an adequate cause. A tool would naturally cut smoothly rather than otherwise, by first intention, as the surgeons say, only that certain causes not only permit, but actually invite, if sometimes they do not indeed insist upon, the chattering. As surely as the straight line is the shortest distance between two points, the smooth cut is always the simplest effect of driving a cutting tool in contact with the surface to be cut. The almost invariable cause or condition which chattering accompanies is an unstable equilibrium in which the tool, or the work if easily movable, is in relation to the other. After the chattering has once begun, if even momentarily, it thereafter possesses in itself a power of self-perpetuation or of self-multiplication that is marvelous and unsurpassed in human experience.

The flat drill which Mr. Rothwell cites is a pertinent illustration. Whoever knew a flat drill, no matter how the lips were ground, that could be made to chatter when drilling solid metal? Whoever knew, again, a flat drill that would not chatter if used for countersinking, or for drilling where the center of it had no hold? In the latter case we may assume, as confidently as possible, that both lips of the drill, the drill being absolutely without steadying hold flatwise, will have on each lip the same cut, the same contact and pressure, and that therefore the lips must cut and travel equally and, which would be the same thing, smoothly. As a matter of fact and experience, it invariably happens that, perhaps at the first movement of contact, or at a very early stage of the cutting operation, there is an infinitesimal preponderance of resistance against one lip or the other, and then the wabbling begins, and having once begun, it of course soon exaggerates and continually perpetrates its diabolically erratic movement.

Reamers often chatter for the same reason that the flat drill with the unsupported center chatters. I cannot say that they ever chatter for any other reason. The hole to be reamed may at the beginning be slightly elliptical, or otherwise out of round, and then one or two flutes of the reamer may have more to cut than the rest, or some may have no cut or contact at all; and in this way the chattering

may begin. It is a frequent experience that reamers will chatter in some holes and not in others, that they are more apt to chatter with a light cut than with a heavy one; and chattering has often been cured by crowding the reamer until the chattering has disappeared, and then, if desirable, reducing the feed for the finishing.

The reamer, to do its work without chattering, needs support sidewise, just as the flat drill does. A reamer preceded by a round end perfectly fitting a round hole could not chatter, for in that case this side support, or this preventive of irregular side movement in any direction, would be provided. The changing of the cutting angle of the faces has practically and directly nothing to do with the case. As no change of the face angle could of itself produce chattering, so no such change could cure chattering.

The round end in the round hole preceding the reamer is not always practicable, for usually the round and parallel hole does not exist until the reamer has done its work. Instead of the round end, the edges of the flutes are intended to be mutually steadying and supporting. After the reamer has begun to revolve in the hole and to do some cutting, the edges, if truly circular, as those in Mr. Rothwell's sketch seem to be, would not allow any chattering. Theoretically, they would be a grand success.

Unfortunately, however, reamers are required not only not to chatter, but to do a reasonable amount of work, and to do it reasonably well in all other respects, and we all know that a reamer like this will not do it. It would be the easiest thing in the world to make reamers with either radial cutting faces or with faces cut under to any angle that might be proposed, and with the outside edges of the flutes truly cylindrical, but nobody is rash enough to propose it, because everybody knows that such a reamer would be worthless. It would require excessive power to drive it, the inside of the hole would be abraded by the friction, and usually the reamer would "seize" and have to be driven or forced out in a demoralized condition from a ruined hole.

A slight clearance given to the edges of the flutes where they bear against the interior cylindrical surface would make all the difference in the world. It is scarcely possible to say how little this clearance might be, but it must actually be provided. It is here really where all the trouble with the chatering reamers comes in. It is not that we do not know very well what is the necessary shape for the flutes of a non-chattering reamer, but that we do not know how to produce it. We know better than we can do. We have no means of finishing the edges of our reamer teeth without giving them too much clearance. Our cutter and reamer grinders are, in the principle of their operation, a manifest absurdity. It is not far out of the way to say that the chattering reamer is the necessary product of our modern facilities for finishing them. The reamers made in the olden time by hand, and finished on the edges with a file, might possibly, some of them, chatter, because too much clearance might be given them; but probably they would not, and generally they did not, chatter, because the expert filer could give them just sufficient clearance without overdoing it. The claim to existence which the modern reamer grinder has is in the accuracy of the sizes produced, which, of course, is incomparably superior to hand work; but as far as I know, there is no reamer grinder in existence that will not necessarily give the cutting edge too much clearance, and so insure the possibility, not only of chattering, but also of rapid wear. Where a convex surface closely approximating the true cylindrical is required, we produce a concave surface, or at the very best a plane. There seems to be no immediate prospect of a better way being provided, and so our trouble from chattering reamers is likely to continue for a while at least.

I see a sure way of curing the disease by homeopathic treatment, and I do not know of any other. Both of the prominent features of homeopathy, as popularly understood, come into play in the case—the use of small doses and the curing of like by like. The small doses, of course, are the small amounts of clearance to be given to the edges of the flutes, or the minute departures from the absolutely cylindrical. The like-cures-like principle is equally simple. The reamer must be wabbled in the grinding of it to prevent its wabbling or chattering when doing its work. The true shape for the edge, the shape which we know well enough theoretically is required, cannot be produced by any revolving wheel operating on a stationary reamer flute, but it may be easily produced by a machine, which hundreds of mechanicians are able to devise, and which will revolve and at the same time minutely wabble the reamer as each of its flutes passes the grinding position. Such a machine might be expensive, but the reamer-makers could easily afford it, and as it would inevitably enable them to produce better reamers, it is not easy to see how they can afford not to build it. If the reamers come to the users correct, there will be a great probability that means will be provided for maintaining them in an equally correct and effective condition.

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Basement Floors for Machine Shops.*

BY PROF. JOHN E. SWEET.

To fix one's ideas in treating this topic, let it be assumed that the ground to be floored is both solid and damp.

With the solid ground only such a depth of filling is necessary as that required to distribute a concentrated load over large enough area, so that a hole will not be punched through what constitutes the floor. Concrete, if of the best quality, may be as good as anything, and the necessary thickness would denpend on the weight of the loads which it had to support. In the writer's opinion a layer of thin flat stone, or two layers, bedded in concrete, and then a thin coating of concrete to give the full depth of say 6 inches, is better than 6 inches of concrete, however good.

To cut off the moisture which is to be expected a coat of asphalt is best. Quick lime would be effectual, but with an unmatched floor the lime would sift through the cracks. The writer believes that a layer of two inch plank is better than scantlings buried in the cement, as it better distributes the load, and joints in the top floor can come anywhere. We have determined by experience that the expected in this case does not happen; the floor does not spring up and down. The top flooring is best of only ⅞ inch stuff, 5½ inches or less in width. When the thin top floor is worn through in places and needs repairing, the hole or depression is only ⅞ inch deep, whereas with thicker top flooring it is deeper.

Were we again to lay a floor we would cut all the top flooring into four feet lengths to facilitate repairing, breaking joints every course.

At the works of John Lang & Son, of Johnstown, Scotland, their shop floor is wholly of iron chips, and is a solid, fairly good floor. Not as clean as a wood floor, but one that would answer well in a basement. The cost of such a floor would depend on the market value of chips. It is cheap to put down and the night watchman can keep it in repair.

The above speculative consideration of the subject is presented for the express purpose of having those who have had experienced give the facts, which, as usual, are more likely than not to upset the theory. What is the best construction for the basement floors of machine shops?

*From Transactions of the A. S. M. E.

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Our readers may remember that in Mr. Miller's letter, which appeared in our issue of June 17th, the Duke of York was referred to as the Mayor of Sheffield, whereas it appears that the Duke of Norfolk occupies that office. Judging by the voluminous correspondence they are sending us, our English friends seem to look upon this mistake as a capital offence; one of them charitably hoping that it occurred in the composing room. In order to save ink and postage on the part of other writers, we take pleasure in making the correction; though we must say that on this side of the pond we cannot understand the importance attached to it.

A New Line of Automatic Gear Cutting Machines.

The Brown & Sharpe Manufacturing Company have recently placed upon the market an entirely new line of automatic gear cutting machines, and have embodied in their construction many improvements suggested by long experience in manufacturing and operating this class of machines.

Fig. 1 shows the general appearance of the full line of machines, except the No. 3, which differs in having an overhanging arm in place of the outer support.

The cutter spindle *A*, Fig. 2, is rigidly supported on both sides of the cutter, and is powerfully and smoothly driven by spiral gears *C C*, thus avoiding the vibration and "chattering" common in machines driven by spur gears, as well as doing away with a belt tightener or other device for adjusting the belt. That part of the spindle, which carries the cutters, is exceptionally large, allowing heavy cutters of large diameters to be used. The changes of cutter speed are easily and quickly obtained by the simple shifting of the belt from one cone to another, thus saving the time and annoyance due to the manipulation of change gears. The cutters are set from a fixed point, not subject to wear and thus can always be set central with the work spindle, regardless of the wear of the cutter slide.

The feed is powerful, direct and has a wide range of evenly graded variations. It is driven by worm and worm wheel, shown at *B B*, Fig. 3, which run in oil. The forward movement of the cutter slide is driven by a positive clutch, thus insuring a positive feed for the cutter, and the return movement is driven by a friction clutch *C*, Fig. 3, of simple construction, easily adjusted by the wedge *T* and screw *W*, which receives the shock of reversing and reduces the strain on the feed screw and working parts.

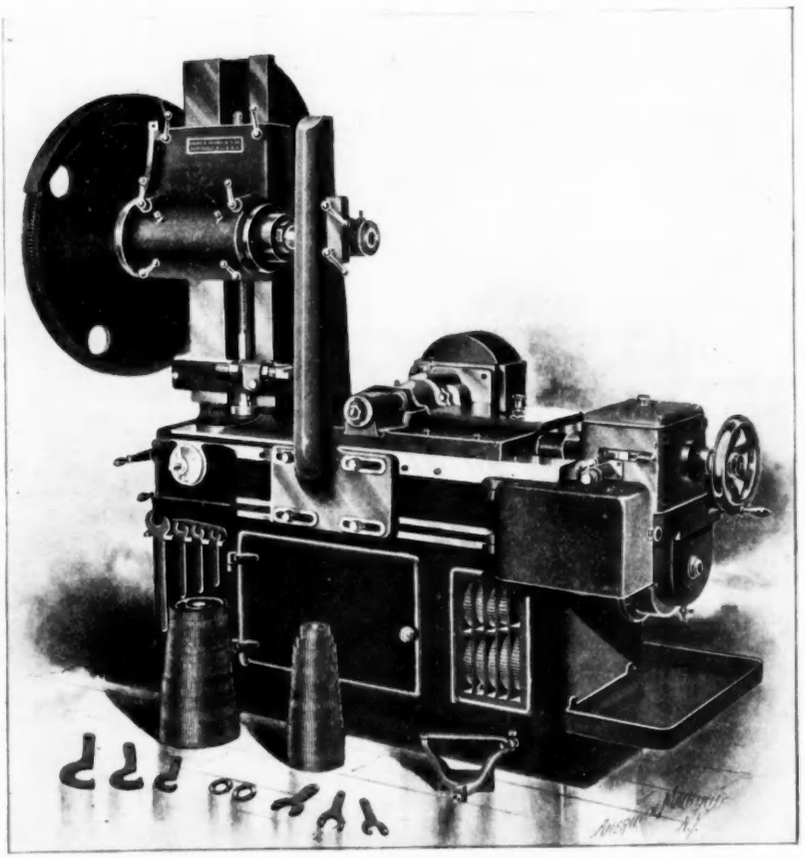
The hand wheel for operating the feed screw by hand, shown in Fig. 3, disconnects automatically and remains stationary when not in use, thus relieving the feed screw of the momentum, due to a constantly revolving hand wheel or crank.

As all the working clutches are made from solid tool steel and have a large number of teeth, the liability of injury resulting from the breaking or working loose of teeth is reduced to a minimum.

Fig. 4, an elevation of the rear of the machine, shows the indexing mechanism, dogs for controlling the movement of the cutter slide, etc.

The work spindle slide is heavy and slides upon the upright, as shown in Figs. 1 and 4. The slide is adjusted by a screw, operated from the front of the machine, and a dial, reading to thousandths of an inch, enables the depth of cut to be accurately determined. The larger machines are provided with means of raising or lowering the slide by power. The diameter of the work spindle is large and amply proportioned to the capacity of the machine. Large taper holes admit the use of heavy arbors. The adjustable outer support, furnished with the Nos. 4, 5 and 6 machines and shown in Figs. 1 and 4, forms a rigid support for the outer end of the work arbor and takes all work to the full capacity of the machine.

The indexing mechanism is unusually rapid and so designed that the liability of error or failure is practically eliminated. The extreme accuracy of the index wheel, together with its large diameter in proportion to diameter of work, insures almost perfect accuracy in the spacing. The unlocking of the indexing mechanism is controlled by the reversing dogs *G G*, Fig. 4, thus admitting of very accurate timing and avoiding the necessity of a separate adjustment. When the machine is cutting, the indexing mechanism is at rest and not subject to the strains of a constantly revolving friction, and the perfection of the mechanism is such that no automatic stops are required to prevent the injury of work. The drive for returning the cutter slide and for indexing is in-



AUTOMATIC GEAR CUTTER.

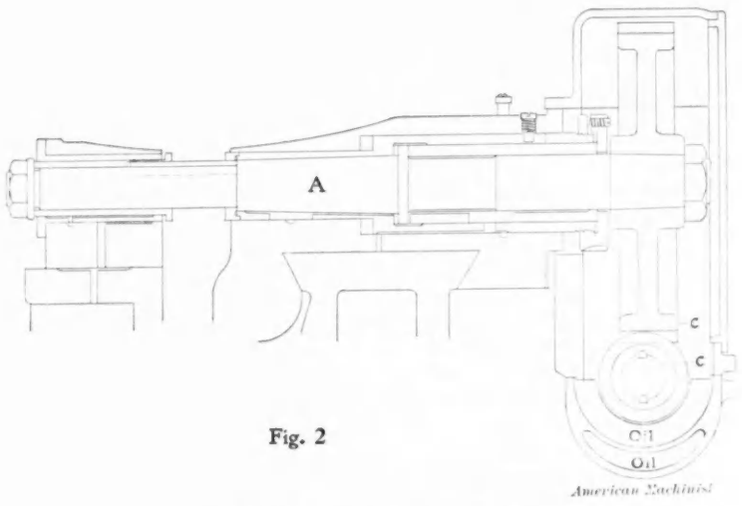


Fig. 2

DETAIL OF GEAR CUTTER.

dependent of cutter drive and feed, and the return of cutter slide and speed of indexing mechanism are rapid and constant, whatever the speed or feed of cutter.

Provision is made to allow for recutting or setting a gear without loosening the gear on the arbor, or the arbor in the spindle, or slipping the teeth of the change gears. The index worm, though rigidly supported, can be unlocked by means of the lever *H*, Fig. 4, and drawn out of mesh with the worm wheel by the lever *I*, the finest adjustments made and the worm positively locked in position.

The withdrawing expansion arbor, furnished with the larger machines, can be drawn back through the work spindle, allowing the finished gear to be removed and the blank placed without disturbing any of the adjustments of the outer support or of the work spindle slide.

Adequate provision is made for oiling all the parts; the driving gears and worms run in oil, suitable receptacles being provided for holding the same.

Ample receptacles are provided inside the base of the machine for catching the chips and for holding lubricant. The chips fall directly from the cutter into the receptacle, thus avoiding the necessity for an automatic device and the annoyance of keeping it in repair; and, when using a pump, the lubricant is taken from and flows back to the reservoir in the base; strainers are also provided for keeping chips out of the pump.

The makers are pleased to show these machines in actual operation and in course of construction at their works.

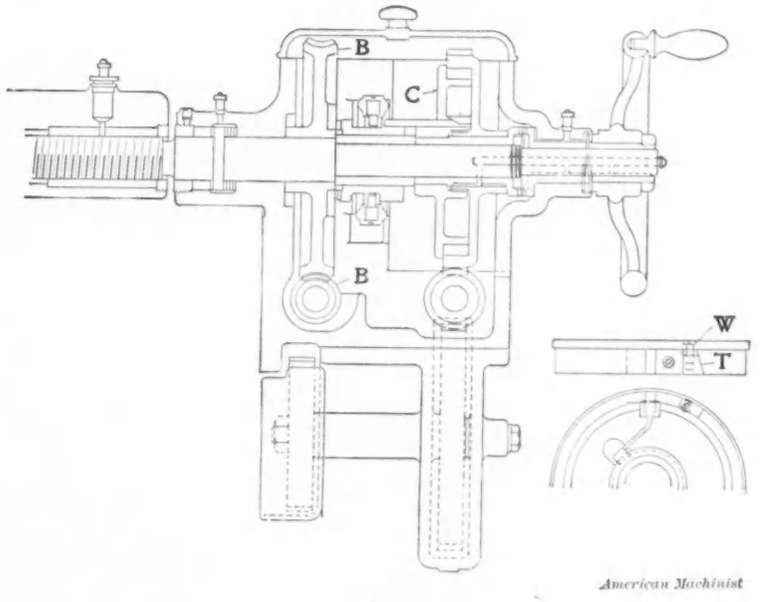


Fig. 3

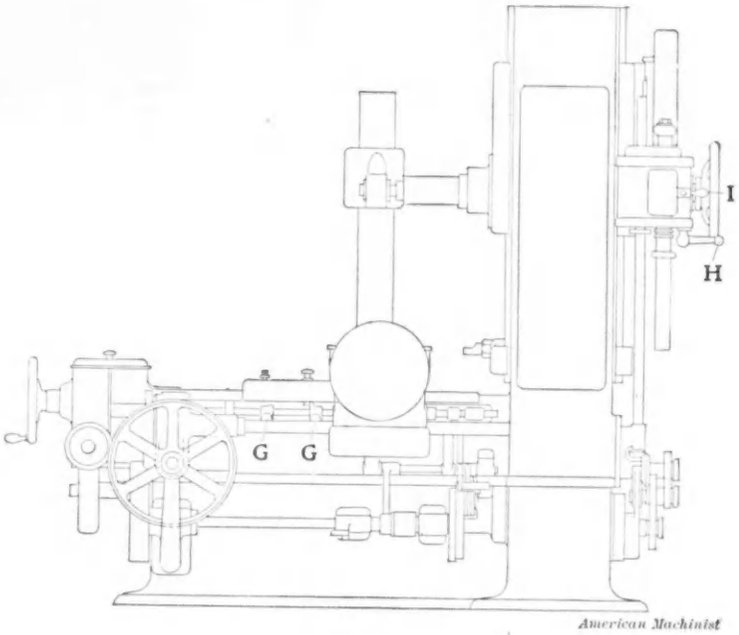


Fig. 4

DETAILS OF GEAR CUTTER.

▲ ▲ ▲

Method of Testing the Magnetic Properties of Iron Used In the Manufacture of Electrical Apparatus.

BY GEO. MOFFAT.

All grades of iron cannot be magnetized with the same facility, as they vary both in hardness and texture.

This variable property of iron is known by the name "permeability."

If a piece of soft iron is wound with a few turns of insulated copper wire, as in Fig. 1, and current be sent through the wire, the iron will be found to be magnetized and capable of lifting a certain weight.

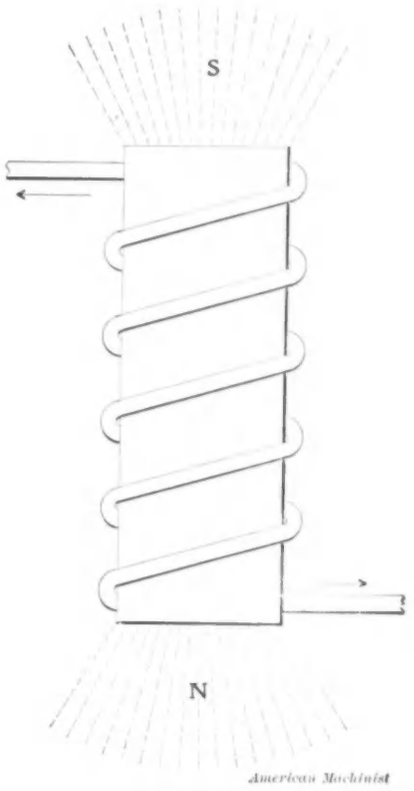


Fig. 1

If the current is increased, the attractive power of the iron will also increase; but if very hard iron or steel is used, instead of the soft iron, it will take much more current to do the same work.

It can readily be seen that it is absolutely necessary, when once a certain design of machine is adopted, to have some method of testing iron to insure that it will not vary too much, or the machines would not be reliable. Fig. 2 illustrates this very graphically: The upper line shows the small amount of current necessary—for very good iron—

to thoroughly magnetize the iron to the saturation point, beyond which it does not pay to push it; while the lower one shows the sluggishness of glass-hardened steel. These are extremes; but it can be seen that if a machine is designed by the upper line and the iron is of an inferior grade, we would have to use more turns of wire or else more iron, which would necessitate a change of design for every machine.

Even the different carloads from the same dealer will vary; so it has been found necessary to have some method for testing every carload bought, and sometimes samples are taken from even smaller quantities.

There have been a number of instruments devised for this work, most of them very ingenious. There is the induction, traction, balance, and a number of other methods with various combinations; but all of them, with the exception of the traction method, are too complicated and delicate for shop work, and really are intended only for the laboratory. The first instrument which could be used in the workshop with any degree of success was one designed by S. P. Thompson, and called by him a "permeameter."

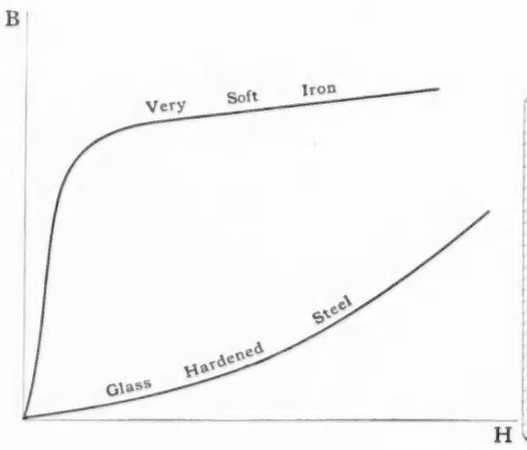


Fig. 2

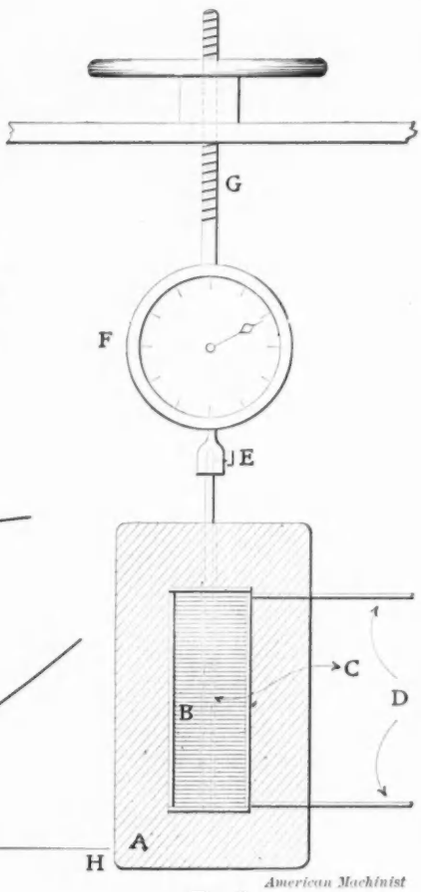


Fig. 3

TESTING IRON FOR PERMEABILITY.

The one illustrated by Fig. 3 was built by the writer, and found by him to give perfect satisfaction.

It is very simple in operation and easily understood. In the illustration, *A* is a block of soft iron 12 x 6 x 3 inches, slotted out to receive *B*, a magnetizing coil wound on brass tube *C*. The sample to be tested is faced up on lower end to make contact on block *A;* the upper end is secured by set-screw *E* to lower part of weighing scale *F*, while *G* is a screw with hand-wheel to put tension on sample, and *D* denotes the wires to carry the current. To test sample, which is in the form of a rod 12 x 1 inch, all that is necessary is to put current through coil—which must be kept constant for all samples—and turn hand-wheel on top until the tension pulls the rod out of coil. The pounds tension on scale is noticed and compared with what is considered "good" by the makers. A small latitude either way is allowable.

The above method, or some variation of it, is the one used by the majority of manufacturers to-day, and while buying iron indiscriminately they can still, by either hardening or softening, turn out machines which are practically uniform.

Letters from Practical Men.

The Mathematician versus the Constructor as a Student—A Word from the Shop.

Editor American Machinist:

In the papers which the "American Machinist" has published on this subject, almost every side of the question has been brought out except the constructor's side, and while everyone has been willing to tell what he believed someone (usually someone else) should do for the constructor, the constructor himself has not had much to say as to what he would like to have done. I am a constructor, and, speaking for myself and my own intimate friends, I may say that the constructor does not want the path made easy on his account alone. If higher mathematics, for example, are useless, he does not wish to waste time with them; but if they are useful to anyone, they are equally useful to him, and he wants just as thorough training as anyone. As a rule, the constructor, so called, will be found to be a student who has had a certain amount of practical training, and is more likely than other students to know why he is attending a university and what he expects to get while there, and I doubt if the class of students that Professor Hutton has in mind when he speaks of "constructors" often need any favors extended to them because of their inability to master the higher mathematics. Personally, I believe that we now get either too much mathematics or not enough; that is, with the amount of time given to it, neither calculus nor analytic geometry becomes a tool—something to be used freely and readily in everyday life as one uses geometry, trigonometry or simple algebra. There is no engineering course that I know of that gives the average student any such freedom in the use of his higher mathematics, and in general the foundation of higher algebra and analytic geometry is usually, possibly always, heavier than is required for the superstructure of calculus which completes the course. Probably if the engineer had a better training in mathematics he would get more good from it; but the majority of us find that the mathematical part of the books we read is comparatively simple, and since, with the usual amount of training, the only possible use of pure mathematics is to enable one to follow what some writer in applied mechanics or some similar subject has already worked out, it seems that we have too much. Modern writers have not followed Rankine's methods in the use of mathematics, and a modern writer practically always gives all but the simplest steps in his mathematical work.

And suppose that a little mathematics can be cut out of the course, what shall take its place?—more theory? more experimental work? The man who suggests it has a low idea of what a university should do for a man. I say add economics, English literature, or any subject of universal interest. There is an old saying, "Live while you live, you will be a long time dead," and one important function of the engineer, in common with the rest of mankind, is to live while he lives; and to live, in the fullest sense, he must find pleasure, instruction and mental stimulus in lines outside his regular work. This the university should enable him to do. Modern machinery has less ornament, more fine finish and more polished work than that designed in the olden time. The modern engineer is devoid of ornament and has the fine finish; but he would be more attractive, and consequently more successful, if he had just a little more polish, and he will make his way in

the world faster just in proportion as he increases the interests which he and the rest of the world have in common.

But to return to the question, while I do not believe that mathematics should be made the one test as to fitness to continue an engineering course, still it has one great practical advantage—it comes early in that course. In our great engineering schools, little, if any, pure mathematics is taught after the freshman year, and no kindness which can be extended to "a hopeless case" can compare with that which takes care that he is "weeded out" in his freshman year while he still has a chance to prepare for some occupation for which he is better fitted, and I am very certain that if mathematics is made the test, the proportion of those who could fairly be classed as "constructors" which is "weeded out" will be found very much less than that taken from the remainder of the class, and if a constructor or two are shut out, it is doubtful whether the university has lost a possible engineer.

Professor Hutton will find that a number of his constructors are shop men, and it must not be forgotten that a man who has worked in the shop during the day and has stuck to his books during the night, has acquired ability to "keep eternally at it," which is equal to any obstacle in a university course.

Finally, to return to the original question raised by Professor Hutton, as to the relative importance of mathematics and of other subjects in selecting the material which the university shall indicate as possible engineers, I wish to propose a test that seems to be the ideal one to apply. I think it will be suggested to all by the following quotation from "The Care and Culture of Men," by David Starr Jordan, President of Stanford University: "The course apparently the most erratic may be the one which brings the student in contact with the strongest men. If a Harvard student of a few years ago could have made his college course exclusively of botany, embryology, Greek, anatomy and early English, it would seem a singular combination. It would sound differently if it were said that his teachers in college were chiefly Asa Gray, Goodwin, Holmes, Lowell and Agassiz." Now, the essential things in an engineering course are, after all, not many, and much of this is now obtainable in our high schools; and another part, I may say the essential part of an engineering training, comes after graduation. Why not give the engineer the bare essentials in his specialty and give him a chance; urge him, if necessary, to do some work under the master minds of other departments. The man on whom such teaching has no influence, who does not respond to contact with the men of energy and ability who have made his university famous, who does not develop enthusiasm for and thoroughness in his work, is a goat. He will never make an engineer; separate him from the sheep.

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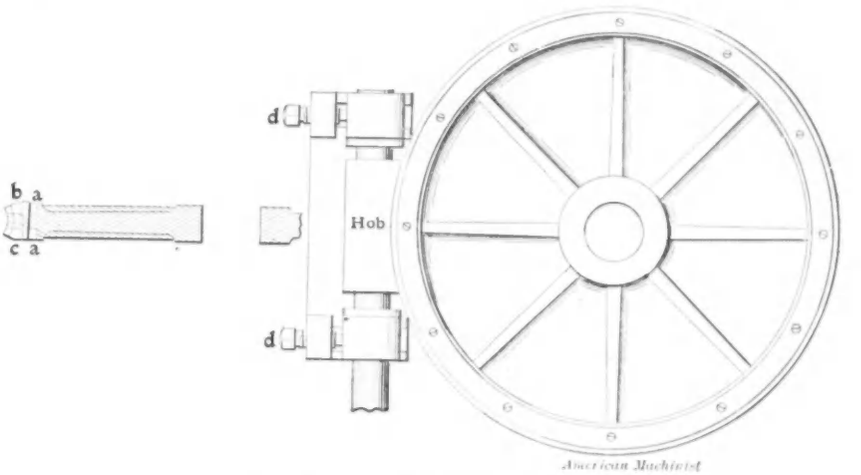
One Way of Making a Good Index.

Editor American Machinist:

A number of years back the firm of C. W. Crary & Sons Company wanted an index for a gear cutter they were building. They turned the blank carefully and had it cut; it was returned to them and was supposed to be perfect, but when placed in the machine and tested was found to be defective. As they wanted one that would produce good work, they turned another blank according to the drawing; then turned two rings to fit on the index at *a* and *a*; then, with a gage swung from the center carrying a bushing, drilled holes at twelve points equally distant from the center and equally distant from each other. After these holes were drilled they were reamed with a taper reamer; then both rings were removed, and ring *b* was moved half way around to the right, and ring *c* was moved half way around to the left and put in place on the index, and the reaming repeated. This was repeated with the rings *b* and *c* in different positions until, no matter where placed around the index, a taper plug gage would show all holes equally spaced. Then twelve taper plugs with a thread on small end were made and screwed into place. The index, with *b* and *c* in place, was then put in a gear cutter and carefully marked. It was then placed on centers on the spindle it was intended to remain on, and hobbed slightly. The rings *b* and *c* were then removed and placed in the position where the error was most perceptible, then fastened in place and hobbed again. This was repeated again and again until, no matter where the rings were placed about the index, there was no perceptible error. The hob used was placed on the same spindle and run in the same bearings in which the worm was to run, and while hobbing was fed into the work by the screws shown in the sketch at *d* and *d*. This index has 240 teeth and is 30 inches in diameter, and, from personal use, the writer can say that no difficulty is experienced in cutting gears accurately on this, which is known in the shop as "the old machine."

ED. SNYDER.

Chicago.



MAKING AN INDEX WHEEL.

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The Glazing of Emery Wheels.

Editor American Machinist:

When an emery wheel fails to cut properly the difficulty is commonly attributed to the glazing of the wheel, and before entering into any discussion of the cause of the trouble it would be well to define a little more clearly what is meant by the term "glazing." Strictly speaking a glazed wheel is one that presents a glassy surface, i. e., one that is smoothed down and reflects the rays of light, such a surface of course having little or no cutting qualities. Another difficulty with emery wheels (much more common than glazing and I think usually confounded with it), is the filling up or clogging of the surface of the wheel by the particles of metal that are ground off the work.

In the experience of the writer, a wheel properly selected for the work in hand will rarely glaze, and when such a trouble does occur the trouble can invariably be traced either to an excessive speed given the wheel or to an excessive hardness of the cementing bond that holds the particles together, the hardness of the particles of emery being always constant.

The action of such a wheel would be as follows: The cutting edges of the emery particles quickly wear off, the hard bond preventing the entire disruption of the grains, which soon lose their cutting quality and begin to take on the gloss and glazed appearance due to the polishing action of the work. Experience has demonstrated that for the general run of work and for the average emery wheel, a speed of 5,000 periphery feet per minute gives the best results. This high rate is neces-

sary to prevent the too rapid wear of the wheels, and it follows that a reduction of the speed of the wheel will have a tendency to increase the wear of the same, crumbling away the dulled and worn out particles and presenting fresh abrasive edges constantly. This is the most reasonable theory of the action of an emery wheel in cutting. If then a speed can be found that will produce this crumbling action in an emery wheel, in the exact degree required, we shall have found the maximum efficiency point of the wheel and shall have pointed out a remedy for a wheel with a glazing tendency.

The conditions that cause a wheel to glaze tend also to cause a wheel to clog, the difference being that in this case the particles of emery do not rub down, smooth nor crumble away sufficiently to form a new cutting surface. The result is undue heating of the work due to the friction engendered. The metal removed also comes off in a fused state, uniting with the particles of emery and in some cases forming a continuous metal coating on the entire surface of the wheel. A free cutting emery wheel will sometimes fill up by forcing it too hard, thereby engendering heat. Again, the character of the metal being ground has considerable to do with the clogging of the emery wheel. It is well known that hardened cast steel grinds the smoothest and best of any ordinary metal, then comes cast iron, soft steel bars and lead, the latter being about the worst of any to fill up a wheel, the same as it will clog the teeth of an ordinary file. Scoring or nicking the surface of the wheel has sometimes been mentioned as a remedy for a glazed or clogged wheel. There is a little virtue in this remedy, but not sufficient. Where the exigencies of the case demand the use of a hard wheel, the writer has sometimes employed a coarse emery brick of a still harder grade to hold against the wheel and thus restore its cutting surface in a measure. The wheel must be turned by hand during this operation, however. On soft wheels that fill up, an old bastard file is preferable to the brick. To sum up this matter, wheels properly selected for the work in hand and manipulated by intelligent workmen will cause little trouble from glazing or clogging, and if trouble is occasionally experienced, the principal remedy is found in a variation of the speed, bearing in mind that an unsuitable wheel cannot be made satisfactory under any conditions.

O. S. WALKER.

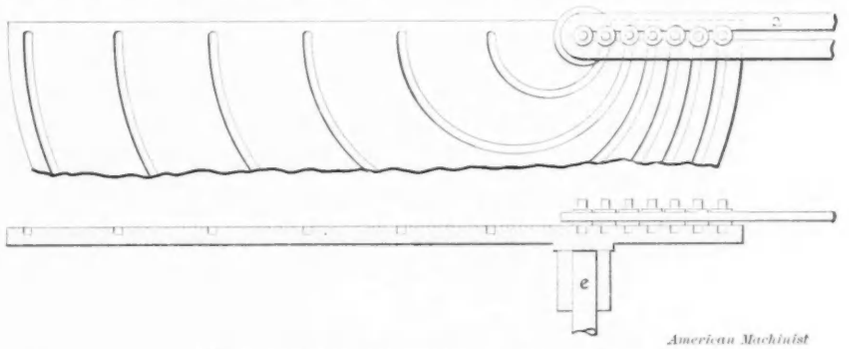
Worcester, Mass.

▲ ▲ ▲

That Special Mechanical Movement.

Editor American Machinist:

The following is submitted as a possible solution of the mechanical problem proposed by H. E. C. in your issue of June 3d. I am by no means satisfied with it, as it has several limitations. The thing to be accomplished, it will be remembered, was the moving of a number of points in a straight line, so that they would be always equidistant, the spaces ranging between ⅛ inch and ½ inch. In the sketch the points or pins are represented as at the ⅛-inch distance, or as near together as they are ever required to be. The pin at the left is fixed, and the others move off to the right, along the slide *a*, as the distances between them are increased. The pins have collars above and below the slide to keep them in place, and a pin also projects below the lower collar of each into the spiral grooves in the horizontal plate below. This plate is carried by the vertical spindle *c*, the center of which coincides with that of the first or fixed pin. It requires no further explanation. When the plate is turned, the pins move out as required. The problem did not specify the number of pins to be moved, and this device is, of course, only practically applicable to a limited number.



THAT SPECIAL MECHANICAL MOVEMENT.

MORRIS FULTON.

[The other suggested solutions of this problem thus far received have been suggestions only, and have not been sufficiently worked out to warrant their reproduction here.—Ed.]

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Best Fire for Working Tool Steel.

Editor American Machinist:

As a constant reader of your valuable paper, I have found in it much interesting information about the proper treatment of tool steel, a subject which one might think has almost been exhausted. But there arose lately a question about the best way of heating steel for forging and hardening, a well-known steel manufacturer claiming as a special advantage of his steel, that it is best heated in ordinary coal (fossil coal), instead of the here rather expensive charcoal. Leaving the gas or the lead furnace out of the question, I always thought charcoal the proper fuel for heating tool steel, and accordingly never allowed it to be heated in pit-coal; but as this steel manufacturer's claim would represent a great saving per annum, I would like to know how far his claim can be right. To make a fair trial is at present not possible for me; but perhaps one of your readers has already tried it, and can tell me the influence of the pit coal and its allies on the steel.

I know that tools heated very carefully in light pit-coal stand very well; but whether they would not stand better if heated in charcoal, I do not know, and besides, tool-makers are not always "very careful" in heating, especially when they cannot be constantly watched.

The tool steel in question is supposed to be of high carbon percentage.

G. NIDECKER.

Mulhouse, Alsace, Germany.

[In comment upon this we take pleasure in reproducing the following.—Ed.]

Editor American Machinist:

I have your letter of the 1st, and beg to return that from Mr. G. Nidecker, Mulhouse, Germany, which has been read with great interest. The subject is one which is constantly coming up in our close touch with steel workers for every description of work. We still find a few who believe that charcoal is indispensable to the good heating of steel, and, unfortunately, these men take it for granted that if charcoal is used as the fuel, it relieves them from even ordinary care in watching the heats, either for forging or for hardening. The fact that a piece of steel can crack if it is heated in charcoal, strikes them as the argument of a steel salesman who is trying to evade the natural consequence of furnishing poor steel. We use in our own works both the hollow forge fire, made of good Pittsburgh coal, and a small furnace which is heated with Connellsville coke. We suspect that the danger in most of the soft-coal fires is from this kind of fuel carrying an excess of sulphur, which, of course, is ruinous to the steel. The Pittsburgh coal is remarkably free from sulphur, and so is the Cumberland coal, which is so largely used by blacksmiths, and excellent steel-heating fires are in operation in hundreds of shops where coke is not available, and where good coal is regularly used. Coke is a very nice, clean fuel; but the coke must not carry more than the smallest possible percentage of sulphur. There are many places in Europe where charcoal is cheap and abundant, and in such cases there is no better fuel to be had; but it does not re-

lieve the workmen from eternal vigilance in watching both the forging and hardening heats. I think that a charcoal fire should be deeper than either a coal or crushed-coke fire, because the pieces of charcoal are apt to be larger than pieces of coal or crushed coke, and when the blast is on, there is greater risk of its playing directly on the steel and heating it in spots in a manner similar to a blow-pipe action. We use at our works for heating ingots, billets and bars in the ordinary course of manufacture, natural gas, coke and coal bottom furnaces. Where small articles are hardened, and especially in fair quantities, the gas furnaces are being very extensively used now. The lead bath for heating is, of course, too well known for further reference. We would say to your correspondent that, if his pit-coal is clean and free from sulphur, he can use it with confidence. I doubt very much if his tools would stand any better heated in charcoal with no more care than if they were heated in pit-coal; but where the latter is used for heating fine tools of high carbon steel, it should certainly be of the character known as a "hollow" fire, and this is virtually a small furnace with coal back and sides.

I. H. PATRIARCH.

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Shop Eye Doctors—That Planer Finishing Tool.

Editor American Machinist:

I have no doubt, but that contributions from machine shop eye doctors are usually acceptable; at least those that appear from time to time in your columns are always instructive and sometimes amusing. It seems that there are different schools in the surgeon oculist as well as in the medical profession, and shop practice shows preferences for these to be about equally divided. For my own part I could not willingly put myself in the hands of a stranger in this line, especially should he display a kit of instruments suited to a surgical operation, or propose to fill my eye with flax seed, or with oil having unknown ingreidents. During a long shop experience I have often been called on to remove specks of iron or other matter from the eyes of workmen, and know of nothing better than the blade of a small pocket knife, preferably, one that is rounded at the point and made very sharp. With this, in a steady hand, the smallest piece of metal that the eye can discern, may be removed without touching the eye. If the piece has adhered, as it will if allowed to remain many hours, it may be necessary to bring the knife in contact with the eye, as near the speck as possible, and by gentle strokes, strike the piece from its fastening. It will then adhere to the knife blade or be washed out by the accumulation of water.

When particles of matter are not attached to the eye, they may be readily removed by a sharpened splinter of wood; this also serves a good purpose for turning the eyelid inside out, an operation which is bunglingly done by many, but when skilfully performed, will not be attended with the least inconvenience or pain. In order to expose as much as possible of the under side of the lid, the patient should roll the eyeball downward. In this way almost the entire surface may be examined and cleared of motes.

It may be well to attempt to describe the operation of turning the eyelid. It is done by taking hold of the eyelashes with the thumb and finger of the left hand, and with a slender stick—such as a match—in the right hand, this is pressed gently sidewise against the eyelid near the eyebrow, and at the same time bearing downward, with the other hand raise the edge of the lid upward and over the stick. When the lid is turned the stick may be withdrawn and used to remove motes, but it is best in the meantime to hold to the eyelashes. A slight downward motion of this hand will restore the lid to its normal position; the lid unaided will not usually do so.

No pretensions are here made to ocular science; the simple practice described above serves well in the machine shop, and is sometimes made available by travelers who meet with some "old chip" when afflicted by a flying cinder.

There are numerous applications used to allay inflammation in the eye, warm water being one of the simplest and best. When this is not obtainable and drug stores are not accessible, pure granulated or loaf sugar serves a good purpose. This should be pulverized as fine as possible, and an amount that will lay on the point of a small knife blade blown squarely into the eye, the lids, of course, being held open while this is done. The first shock experienced is somewhat unpleasant, but you close the eye without being told to do so, and an instant after the sugar is dissolved, and the effect is most gratifying, the eye being soothed immediately. This may seem to some as absurd as some other practices of which we are told; but I have tried it, and know whereof I speak.

I accept the qualification made by Mr. Wm. Pilton, in the "American Machinist" of May 13th, concerning the planer tool described in a previous number. Of course, where work is to be finished by hand, the higher tool finish may not be desirable. I still believe, however, that this tool will hold an edge longer when a lubricant is used, especially when used on wrought iron or mild steel.

As to that percentage question, I adhere to "one in ten" meeting with success when first attempting to make and use this tool, especially when guided only by the descriptions given by Mr. Pilton and myself. It would certainly be a little strange if the gentleman who quoted me had failed after having an exact pattern of the tool placed in his hand. It is both thoughtful and kind in Mr. Pilton to furnish his friends exact models in wood. I dare say the demand for these will be such as to put to the test the generous impulse that originated the scheme. QUIRK.

▲ ▲ ▲

A Pattern-Making Wrinkle.

Editor American Machinist:

Some years ago a native of Japan explained to me how those intricate bronze castings are made in his country, and it occurred to me that the simple and ingenious method might sometimes be of value to engineers in this country. It is quite possible, however, that it is already well known and in use here; not being in that business, I do not know. The method is limited to making a single casting; but it might also be of value in making a metallic pattern for other castings, which would be much cheaper than a wooden one. The method consists merely in modeling a pattern in wax, then surrounding this with a mass of plaster or some refractory material in the form of a paste. When this is hard, the whole mass is heated, allowing the wax to run out through holes provided for that purpose; the metal is then poured into this mold. CARL HERING.

Philadelphia.

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The Coefficient of Friction.

Editor American Machinist:

In your article on Tests of the Hyatt Roller Bearing, in your issue of June 24th, it is stated that the coefficient of friction is "of course the proportion of power transmitted, which was lost in the bearing under the conditions noted." This is a new definition for "coefficient of friction," and I don't think it is a correct one. If the figures given in the table really represent "the proportion of power transmitted which was lost in the bearing," then the Hyatt roller bearing must be an exceedingly inefficient bearing, some of the figures showing a loss of power of over 3 per cent. Will you please explain? THERMICUS.

[The gratuitous definition of the coefficient of friction in the article referred to was absurd, and should be disregarded, or at least it should have no connection with the tests of the Hyatt roller bearing. —Ed.]

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Strictly Pure.

Advertisers who announce that all the materials used by them are strictly pure make a strong point, and customers should purchase only of them. They should be sure that they have only pure chicory in the coffee, pure terra alba in the candy, pure rosin in the beer, pure petroleum in their lard oil. The latest advance seems to be in the direction of introducing large proportions of pure corn meal into wheat flour. The mixture of strictly pure ingredients must itself be pure.

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▲ ▲ ▲

English Representative.
R. E. Howard, 9 Leonard St., Finsbury, London, E. C.

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Space in advertising pages only is for sale.

We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

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SUBSCRIPTION PRICE:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

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Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers, Everywhere.

No back numbers beyond 1896.

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Blueprints.

It is probably true that we are none of us quite satisfied with the blueprint. It does not do precisely what it undertakes to do. A reproductive process should reproduce absolutely. The half-tone does the business for the photo much better than the blueprint does for the working drawing. The blue surface and the white line, although legible enough, and serving our purpose for practical use, are not, after all, the real thing. The reversed shading does not appear right to us even with unlimited and continuous familiarity. Other things being equal, we would all jump at the process that would give us the genuine black lines on the white paper.

And yet, when the blueprint first put in its appearance, it is to the credit of engineers and mechanics everywhere, that they at once recognized its value and universally adopted it. It required no advocacy by anyone, and no one made a fortune out of it or secured a monopoly of it. It began to be known about a score of years ago, and to-day we may well wonder what engineers and architects, and all who use eyes at their work, could do without it.

It is still, however, quite doubtful whether, while we all use it as a convenience, or, rather, now as a necessity, we any of us realize its value, or fairly estimate what it has already accomplished. It it a great convenience, a great labor-saver; but, like other labor-saving devices, it entails in its application consequences not generally or immediately foreseen. The short time which has been required to secure its complete and world-wide adoption, and to develop the results of its usefulness, makes it a unique example of the operation of labor-saving devices. We cannot recall an instance where, from so few years of use of a labor-saving appliance, the final results of it are so easily apparent.

The blueprint reproduces, among other things, mechanical drawings, saves the labor of the draftsman; with the result, not that draftsmen are thrown out of work, but that more draftsmen are employed than ever before. The universal circulation of the blueprint has been a powerful stimulating and educating influence in the shops, and the use of the drawing in the shop has vastly increased. The general style and character of drawings in use has been much improved. The blueprint has quite enlarged and transformed the sphere of the shop drawing. It is not now exclusively for shop use, but is the means of communication with the outside world. This has put the shop proprietor and his draftsman upon their dignity, and incited them to pride in their work and work to be proud of. The drawing that was good enough for private use is not good enough to be sent out by copy wherever occasion may call for it. While draftsmen are thus employed in the production of better drawings, and many more of them, they are, of course, distinctly elevated, instead of being degraded by the blueprint. They are employed upon more original and independent and generally better work. The drudgery of mere copying as the only means of reproduction has disappeared, and the copy or tracing is now in most cases the only drawing made, and must therefore usually be made by the draftsman himself, instead of being boy's work. The cheapness of reproduction and the consequent wide circulation of the blueprint has been a means of widely diffusing a knowledge of advanced shop practices and of stimulating a rivalry in their adoption. The mere presence of the stranger blueprint in the small shop, or in the shop that is not up to date, has been often that of a missionary, and has led to the adoption of modern methods in machine work. The complete drawing preceding the shop work instead of coming after it, if at all, mistakes made upon paper instead of in iron and steel, and discovered and corrected in the beginning instead of at the latter end of the job, is more generally the modern mode of procedure, and the blueprint has distinctly promoted its adoption.

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Good Roads.

Professor Sweet, in this issue, has some striking suggestions to offer upon the subject of good roads, of our lack and our need of them in the United States, of some apparent reasons for our deficiencies, and of the direction in which the remedy may lie. If any better mechanic can find a more pertinent and distinctly mechanical topic, or one more in need of sound advice and able and earnest advocacy, we do not know where to find the combination.

It ought not to be as it is. We should not need to say a word to our readers in advocacy of the steel ball or the steel roller as an anti-friction device, and it would seem a manifest absurdity for us to call attention to the fact that the success of the ball or roller does not reside in either alone, and that smooth and easy running is not accomplished by any number of either without suitable paths to travel in. The accuracy of the surfaces with which they move in contact is quite as essential a part of the arrangement as are the balls or rollers themselves.

How is it different with the wheeled vehicle, and why should it be any more necessary to say that the wagon wheel needs a smooth surface to travel on than to say that the ball bearing or the roller bearing surfaces should be true and smooth? Our wheeled vehicles, the country through, have cost a pile of money, and the means of their propulsion are costly. What if the general cost of conveyance were cut in two and one half thrown away, or the speed of all traffic were proportionately increased? This good roads would surely, and at once and permanently, do for us. Absolutely no argument is needed to show a possible fifty per cent. saving here, while in almost every department of human occupation we are gaining our economies usually by single units of percentage.

Surely nothing can be of more importance, mechanically, than thorough lubrication. The best of oil, or the roller bearing at the axle, is none too good, as all are agreed. But to run the wheel finely lubricated at the axle along the average rough country road, is to lose at the periphery far more than we save at the center. It is waste at the bung, while we save at the spigot.

The success of the railroad was in the rail more than in any other single detail. New modes of locomotion are now quite distinctly coming in sight, and they wait

for nothing more necessary to their ultimate success than the universal smooth road to run on. It is undoubtedly this more than anything else, that is developing the motor car more rapidly in France than with us. A few fine asphalted avenues, which every city can boast, are only an aggravation. It is the worst piece of road that the vehicle may have to traverse, and not the best, that will limit and determine its satisfactory operation, and it is the worst roads to which our earliest attention should be given. It must be conceded that we have altogether too many of them. Professor Sweet's suggestion as to the widths of our roads is a valuable one. Of the good roads that we have, we might have had double the length with half the width for practically the same cost, and grass and trees for the rest of it to gladden our eyes, instead of dust and glare to blind us.

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Technical Books.

PRACTICAL PLATING AND POLISHING, with a Special Article on Nickel Plating and Polishing—Bicycle Work—Giving the best and most approved methods of preparing and cleaning all metals for electro-plating and polishing. Illustrated. New York: Zucker & Levett & Loeb Co. 114 pages. 7¼ x 4½ inches. Price 80 cents.

This is a strictly practical work, containing clear and full information upon the subjects treated, and should be a valuable handbook for all who have polishing or plating in any metal to do. There is no extraneous matter in the book, except eight pages of unmistakable padding.

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A Machinery Blue Book.

A tool dealer is judged by the catalog he prints. This aphorism is inapplicable in regions where the names of his tools are machine-shop words; but in pioneer territory it begins to take hold. So now, when the scramble for European trade is at its liveliest, he is a wise man who clothes the descriptions of his machinery in attractive dress.

Messrs. Hill, Clarke & Co., of Boston, have this year produced a catalog which is something more than a catalog, and we take pleasure in giving it more than our accustomed catalog mention. It is a handsomely gotten up volume of 402 pages. With every machine advertised there is a terse description in which the salient features are alluded to in well-chosen words. Especial pains have been taken with the illustrations, which present the appearance of careful preparation, and are dealt with justly by both paper and press work. It does not appear whether the publishers intend this book for foreign circulation, but if so, it will fail to bear out the remark frequently made, and no doubt truly, that trade publications in English cannot be appreciated on the Continent.

An unusual feature in such catalogs is the giving, in each case, of the maker's name.

There is always room at the top—in heating. There is no assignable upper limit to possible temperatures, while going downward the bottom of the stairs seems to be visible.

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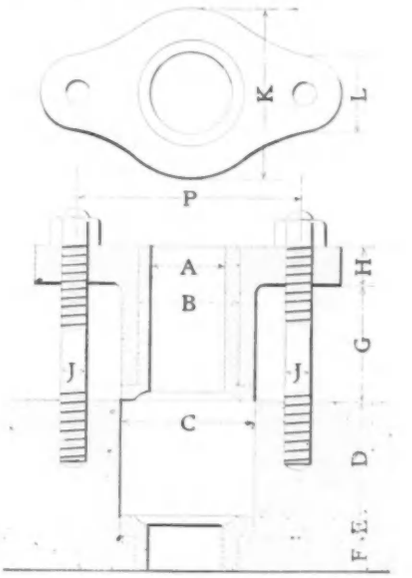
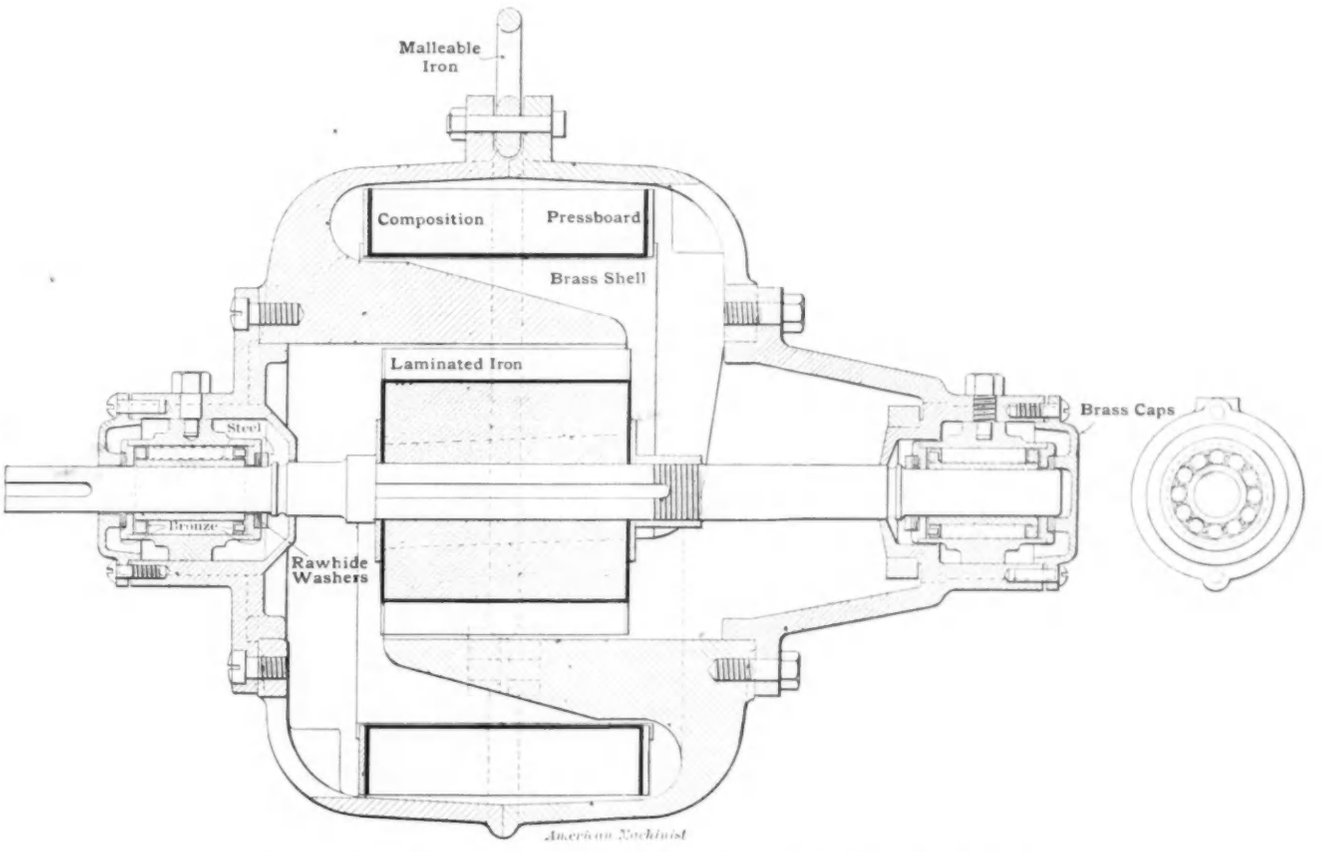
In consequence of the haste incident to holiday week, the two following engravings were omitted from our last week's make-up. They explain themselves.



DRAWING WITH BLUE PRINT FOR STANDARD STUFFING BOX.



THE LUNDELL MOTOR, AS APPLIED TO THE NEW YORK HANSOM CABS.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(108) W. N. K., Avery, Kan., asks: What cold-water pressure would you advise in testing an old 20 horse-power boiler which never carried over 80 pounds steam pressure? A.—The cold-water test is not considered reliable as applied to old boilers. A thorough inspection by a competent man will tell far more about the condition of the boiler, and the pressure under which it is safe, than any cold-water test.

(109) X. Y. Z., Blankville, asks: In what manner is a Y-branch casting for a section of cast-iron pipe strengthened to overcome the weakness due to the hole in the pipe where the branch unites with the main? A.—On small pipe no extra thickening is necessary. On larger sizes it is usual to thicken up the metal at the junction, and in the case of very large Ys, bolts are put clear across the diameter of the pipe, which act like stay-bolts in a locomotive firebox.

(110) G. A., San Francisco, Cal., asks: Which of the American tool-builders can plane the longest piece of work, and how long? Do they use the ordinary planer for that class of work, or have they something special? A.—It is probably safe to say that that shop can plane the longest piece which can get the longest piece to plane. The Pond Tool Works, for instance, did some long planing upon the gun lathes for the Watervliet Arsenal; but there can be little doubt that they could plane much longer work if required. We have not looked into the details of practice at the Pond shops, but we have seen long work planed upon a common planer by bolting another platen endwise to the regular platen of the machine, and supporting it, as it ran out over either end, upon rollers carefully set.

(111) C. B. C., Erie, Pa., asks: Is there a United States standard for the diameters of the heads of cap screws? Most of the screw manufacturers add ¼ inch to the diameter of the screw to obtain the diameter of the head across the flats for sizes above ½ inch. There seems to be some misunderstanding on this point, however; one company claiming that the United States standard cap screw head is the same as the standard bolt head or nut. A.—The United States, or Sellers, standard applies properly only to bolts and nuts; but there is no reason why it should not be equally applicable to cap screws. The standard of the leading screw-makers seems to have been adopted with a view to saving as much stock and labor as possible. It gives an ugly head with insufficient bearing, and it is strange that it is so widely accepted.

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A notable increase in the distance covered by electricity in the transmission of power is about to be undertaken in a plant which is to transmit power a distance of 80 miles, from Santa Anna Canon to Los Angeles and Pasadena, Cal., and the contract for which has just been closed with the General Electric Company. There are to be four generators of 750 kilowatt (1,000 horse-power) capacity each. The line voltage is to be 33,000, being the highest yet undertaken. The water wheels will be of the impulse type, mounted on the generator shafts and will operate under a head of 750 feet.

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Personal.

Mr. F. W. Boye has opened an office in Berlin, Germany, as the representative of Dietz, Schumacher & Boye.

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Commercial Review.

NEW YORK, Saturday Evening, July 10.

DYNAMOS AND MOTORS.

The early portion of this month seems to have proved a period of hiatus in regard to the large and important class of contracts, of which several were placed a short time since. A retrospect of the past few weeks shows important electrical machinery deals, notices of which have already appeared in our columns. One of the largest electrical concerns, the General Electric Company, received the Central London Underground, and the Sydney, Australia, railway orders, in connection with the former of which, it may be added, the Sprague Elevator Company took contracts for 49 large elevators, which is said to be the greatest elevator sale ever made. As far, at least, as the work of the General Electric Company goes, this has been a successful year in the street railway line, nor are they the only concern who have so found it. Another notable line of work has fallen to their chief competitors, the Westinghouse Company, namely, the execution of the Massena, N. Y., water-power contract, which our Pittsburg report last week should have stated to comprise fifteen generators, of 5,000 horse-power each, an aggregate of 75,000 horse-power.

Just at present, the orders seem to be of a minor character, but are coming in right along to the satisfaction of various of the companies of whose state we are cognizant. Yet it can hardly be said that July has opened with great show of activity. Trade is of a mild character. Still the electrical business is not one which can be fairly judged by short periods of time.

NEW INSTALLATIONS OF ELECTRICALLY-DRIVEN MACHINERY.

The Ulster & Delaware Railroad has contracted to install electrical machinery in its shops. The plant will include two 100 kilowatt Crocker-Wheeler dynamos, three 40 kilowatt machines and a number of motors.

We believe that it has not hitherto been officially given out that the Siemens & Halske Electric Company have installed an electrical equipment for running the mill of the Liondale Bleach, Dye and Print Works, at Rockaway, N. J. It comprises some twenty-five dynamos and motors, the former being from 300 kilowatts down.

A printing establishment which has just decided to introduce electrical power is that of the Buttrick Publishing Company, New York, who have contracted for Crocker-Wheeler machines.

RAILWAY, LIGHTING, ETC.

There is a new factor in the field of alternating dynamo and motor manufacture. The Walker Company have announced themselves as entering it, and are about to extend their scope to arc-lighting dynamos also.

We are in receipt of a circular of this company, which describes the operations which are progressing in the installation of electricity upon lines of railroad controlled by the Suburban Railroad Company, etc., of Chicago, and hitherto operated by steam. The Walker Company furnish generators and car equipments. The work has been so far carried out that one of the roads was to run by electricity July 1st. The cars are so equipped as to run in part with overhead trolleys and in part on an elevated trestle where the current is applied by the third-rail system. The present machinery outfit of the power-house consists of three sets of Sterling water-tube boilers of 250 horse-power each, with Meisner stokers and two Greene tandem compound engines, the larger of which is directly connected to a 400 kilowatt and the smaller to a 240 kilowatt generator. A dynamo of 800 kilowatt capacity will be added, with the additional power required to run it.

More or less is being done all the while in lighting dynamos; but we have not heard of the closing of any of the pending office-building contracts. A 60-kilowatt direct-connected C. & C. generator has been ordered for a large new drygoods store in this city.

The C. & C. Electric Company have experienced an improvement of business during the past four or five weeks. Its character is considered healthy, because it extends through the various lines of their work about evenly, and is marked by an increasing number of small orders. They have increased their factory force.

FOREIGN FRAGMENTS.

An electric street railway is proposed to be installed at Ghent, Belgium, and United States Consul Morris has forwarded plans and specifications to Washington.

A company called La Société d'Eclairage Electrique de St. Petersburg has been chartered in Brussels, for the purpose of lighting the public streets of St. Petersburg, and will need machinery.

An exhibition by the Russian Electro-Technical Society is planned to be held in St. Petersburg in 1899, the exhibits afterward to be retained there as an electrical museum. This will afford an opportunity to introduce various American electrical

goods which have never before entered that market.

"PROSPECTS FOR UNITED STATES MACHINERY IN BELFAST,"

is the title of a report of Consul Taney, at Belfast, as appearing in an advance sheet issued by the Department of State. In answer to some questions addressed to him by a Chicago manufacturing company, he gives information, of which the substance is as follows: That the commercial methods there are quite similar to our own; that some kinds of American machinery are now there, but not, so far as he knows, for moving earth, road making, etc.; that the people, though conservative, are fairly quick at discerning the economy and good qualities of machinery, and that considerable work is being done in the city, in the way of public improvement—such as deepening docks and enlarging quays—for which first-class labor-saving machinery is required; that important water-works and sewerage projects are now on foot there, which are given in detail, with the names of contractors for pipe, etc., to whom awarded; that the following large and responsible firms might handle machinery of the nature above alluded to: Musgrave & Co., Ann street; J. Riddell & Co., Ann street; T. Dixon & Sons, Corporation street; Gregg, Sons & Phoenix, Church Lane. That while correspondence and illustrated catalogs may bring a little business, personal work is almost indispensable, if the interest involved will justify the outlay.

Quotations.

NEW YORK, Monday, July 12.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $12 50
No. 2 foundry, Northern	11 00 @ 11 25
No. 2 plain, Northern	10 50 @ 11 00
Gray forge, Northern	9 75 @ 10 25
No. 1 foundry, Southern	10 50 @ 10 75
No. 2 foundry, Southern	10 00 @ 10 25
No. 3 foundry, Southern	9 75 @ 10 00
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	— @ 10 50
Foundry forge, or No. 4, South'n	9 50 @ 9 75

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.05c.; refined, 1.10 @ 1.15c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.35 @ 1.45c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.50c.

Cold Rolled Steel Shafting—The manufacturers' combination is off, and the price is quotable at about 2¼c., in small lots, from store.

Copper—Carload lots, Lake Superior ingot, 11⅛ @ 11¼c.; electrolytic, 10⅞ @ 11c.; casting copper, 10⅝ @ 10⅞c.

Pig Lead—In carload lots, 3.70 @ 3.75c., f. o. b. New York.

Pig Tin—For 5 and 10-ton lots, 14.00 @ 14.05c., f. o. b.

Spelter—In carload lots, New York delivery, 4.20 @ 4.30c., f. o. b.

Antimony—Cookson's, 7.35c.; Hallett's, 6.95 @ 7.00c.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 35 @ 37c.

Manufactures.

The Macon (O.) Shear Company is erecting a new factory.

At Alvarado, Cal., the beet sugar factory is being enlarged.

Hetrick Bros., of Toledo, O., contemplate the erection of a factory.

At Lindenhurst, N. Y., Ernest Henke is erecting a factory building.

At Philadelphia, Pa., Charles H. Bockins is to have a new factory erected.

At Albany, N. Y., the foundry of Haight & Clark has been visited by fire.

The Albion Iron Works, of Victoria, B. C., have lately enlarged their plant.

The planing mill of Seiss Bros., Alexandria, La., was recently destroyed by fire.

J. S. Barrow, Louisburg, N. C., expects to install machinery for a small plant.

(*Continued on page 36.*)

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Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Gear and milling cutters, adjust. reamers, counterbars and tools, vert. millers, drill pr., cutter and surf. grind., shears. R. M. Clough, New Haven, Ct.

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York, Room 212.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Draftsman, experienced, all-round mechanic; moderate salary; desires pos. Box 88, Am. Mach.

By exp. machinist, toolmaker; comp. and reliable; handled help 11 years; hard work'r. Box 89, Am. Mach.

Wanted—Situation by experienced foundry foreman; up-to-date and progressive in modern foundry practice; results assured; no experiment; references. Box 90, American Machinist.

Europe—M. E. and E. E. and prac. mach., speaks Eng., German, French, would travel Europe for tool mach'y as representative or expert. 20 years experience. Best references. Box 73, Am. Mach.

Wanted—Position by first-class brass foundry foreman; mixes metal from old and new stock; years of experience in handling men, boys and girls; first class reference. Address Box 91, Amer. Machinist.

Pos. as supt. or assistant supt. by up-to-date, progressive young man, tech. graduate, exp. in mod. shop methods, also draughting; strictly temperate; good ref.; member A. S. M. E. Box 86, Amer. Mach.

Help Wanted.

Wanted—A first-class, sober and reliable machinist blacksmith in small country town, one hour distant from New York. Also an experienced brass polisher. Address Box 81, American Machinist.

Wanted—A machine foreman in an Illinois shop, building Duplex Steam Pumps and steam specialties. Do not apply unless you have had recent exp. in Duplex Pump work. Box 93, Amer. Machinist.

Foremen, tool-makers, machinists, salesmen of exceptional ability, wanted at large English cycle works making everything including castings, tubing, etc.; reply giving qualification, experience, age, length of engagement and salary required; personal interview can be arranged. Ad. Box 85, Am. Mach.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Patents, Machinery Designed, Drawings. Henry F. Noyes, 56 Liberty Street, New York.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Wanted—Iron planer, second hand, about 28" x 28" x 6'; state prices. H. L. McCullough, Cropsey, Ill.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

"Modern Steam Engine Construction," parts 1 to 10; 30 cents each. T. F. Scheffler, Erie, Pa.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Model Locomotives—Complete castings, latest N. Y. Cen. standard, up to date; 4c. in stamps for cat. alog. G. H. Olney, 163 Herkimer St., Brooklyn, N. Y.

Machine shop and foundry in New England manufacturing town of 8 000 population, either or both to rent, or will sell stock, tools and machinery. Box 92, American Machinist.

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern, cheap and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

For Sale—Machine shop, with fine tools, milling machine, lathes, drills, etc.; doing a good business; best of reasons for selling. A good bargain for $3,500. Address Box 71, American Machinist.

For Rent—A machine shop in connection with our factory; traveling crane and all conveniences; power, heat and light supplied; railroad siding; rent may be paid in work. Address Delaware Hard Fibre Co., Wilmington, Del.

Wanted Capital, $10,000—A one-half interest in an established machine tool company is offered a practical man having the executive ability to conduct the business. Strictly modern shop and equipment with ample orders. Address Box 49, American Machinist.

A machine shop, with modern equipment, heavy and light machinery, cranes of 20 tons capacity and 10,000 square feet of unoccupied floor space, would contract to manufacture any kind of machinery. Parties already having machinery built under contract might do well to write us for estimates. Box 62, American Machinist.

Die and Tool Steel.

NO BETTER MADE.

CRESCENT STEEL CO.

PITTSBURGH, PA.
CHICAGO, ILL.
NEW YORK, N. Y.
DENVER, COL.

AUTOMATIC FRICTION CLUTCH CO.

CATALOG ON REQUEST.
821 STATE STREET,
ERIE, PA.

(*Continued from page 35.*)

Graham Bros., of Oakland, Cal., are having an addition made to their foundry.

At South Windsor, Conn., the paper mill of H. G. Church was destroyed by fire.

Messrs. A. Weiskettel & Son, of Baltimore, Md., will soon erect a new foundry.

At Lincoln, N. J., the Franklin Company contemplate the erection of a factory.

At Camden, N. J., the works of William J. Cooper are to have an addition erected.

Bates Bros., of Athol, Mass., contemplate making improvements to their factory.

The pumping station of Milford, Mass., is to be enlarged and new boilers installed.

The Burlington Cotton Mills, of Burlington, Vt., will make extensive repairs shortly.

The Nazareth Manufacturing Company, of Easton, Pa., are erecting a new building.

F. H. Chappell & Co., of New London, Conn., are erecting a three-story brick structure.

The Walker Soap Company, of Pittsburg, Pa., contemplate the erection of a factory.

A. J. Beach & Co., Tulip street, Philadelphia, Pa., are having additions made to their plant.

The city of Cleveland, O., contemplates the installation of boilers in its waterworks system.

The American Tin Plate Company, Elwood, Ind., has commenced the enlargement of its plant.

The planing mill of the Griffin Lumber Company, at Sandy Hill, N. Y., has been destroyed by fire.

The Lake Superior Carbide Works, at Sault Ste. Marie, Mich., will soon install new machinery.

It it probable that Messrs. Strohmeyer & Purdy, of Altoona, Pa., will remove their plant to Piqua, O.

The Port Royal Coal & Coke Company, of West Newton, Pa., are to make additions to their plant.

The Montezuma Mining Company, near Kaslo, B. C., it is expected, will put up a concentrating plant.

The plant of the Akron (O.) Iron & Steel Company has been damaged by fire to the extent of $100,000.

The Shaw Steel Casting Company will probably erect a factory on Marquette avenue, Milwaukee, Wis.

It is expected that the works of the West Newton (Pa.) Ground Lime & Cement Company will be enlarged.

At Bridgeport, Conn., the Bridgeport Milling, Mining & Smelting Company contemplate the erection of a new mill.

The plant of the Avery Stamping Company, at Cleveland, O., has been destroyed by fire, inflicting considerable damage.

The Lemon Gold Mining Company of British Columbia, with headquarters at Omaha, Neb., has filed articles of incorporation.

The Crystal Mountain Mine & Reduction Company, of Buckley, Wash., are contemplating the erection of a stamp mill.

The Chicago Engineering Company, of Chicago, Ill., has been incorporated by H. E. Shedd, H. J. Brownell and J. S. Joslyn.

The Birmingham (Ala.) Rolling Mill Company have increased their capital stock, and the capacity of the plant will be increased.

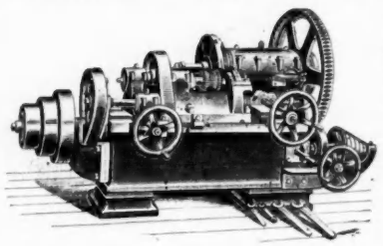
The Texas & Pacific Railroad shops, at Marshall, Tex., are being enlarged, and tin, boiler and hand-car shops are being constructed.

Among new Canton (O.) corporations is the Ohio Supply Company. Incorporators: N. E. Young, D. Jenkins, Henry and T. Snyder.

At Hartford, Conn., Hon. Thomas Ryan and

(*Continued on page 37.*)

CIRCULAR MILLING MACHINES



For milling the peripheries and edges of gears, pulleys, etc., in straight, angular and curved lines, and for other work of a similar character. Nos. 0 and 1 machines are arranged for external and internal milling. No. 3 for external milling only. Are very stiff and powerful, and do their work four times as fast as is done by lathes, and produce a smooth surface.
Milling Cutters in all styles and sizes. GEAR CUTTING and SPINDLE DRILLING to order.

Ask for Machinists' Catalogue.

THE PRATT & WHITNEY CO.,
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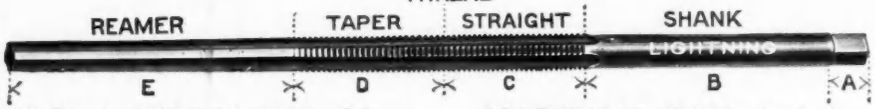

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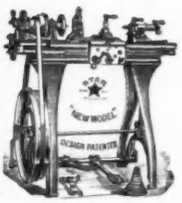

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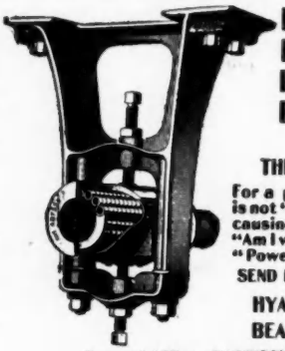

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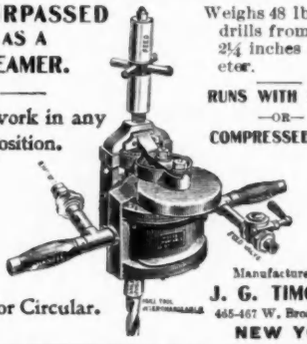

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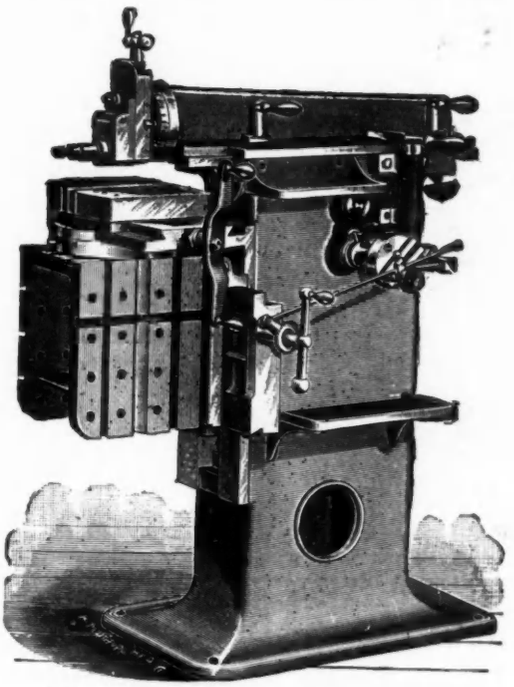

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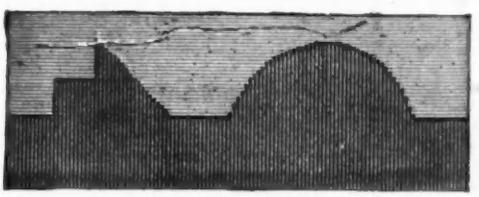

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(Continued from page 36.)

Hugh Morgan, of Syracuse, N. Y., are interested in a brewery to be erected at that place.

The Blakeslee Forging Company, of Southington, Conn., are contemplating erecting a large addition to their factory at Plantsville.

The Columbia Phosphate Company, of Columbia, S. C., of which Mr. W. A. Clark is president, has commenced to enlarge its plant.

At Chicago, the Gorin Tabulator Company has been incorporated by C. C. Bartlett and A. S. Rasdall to engage in general manufacturing.

At Pittsburg, Pa., it is reported that Epping, Carpenter & Co. will erect a plant at Forty-third street and Allegheny Valley Railroad.

At Chicago, Ill., the Lake Manufacturing Company has been incorporated by J. W. Beckstrom, W. J. Matthews and C. Van Alen Smith.

The Verder Manufacturing Company, of Hartford, Conn., has purchased a piece of ground upon which it intends to erect a new factory.

John Woodhouse, secretary of the Lehi Sugar Factory, states that the company contemplate the erection of another plant at Ogden, Utah.

The Belmont Iron Works, of Philadelphia, Pa., has been incorporated by S. Genge Brown, James B. Willets, Joseph Willets, H. B. Hirsh, etc.

At Richmond, Ind., the Fulton Steam Boiler Works has been incorporated. The directors are John T. Caulfield, W. C. Ferguson, J. S. Reeves, etc.

The Diamond Match Company, of Barberton, O., contemplate the erection of a building 80 x 200, to be used for the manufacture of safety matches.

The Kentucky Mining Company, of Earlington, Ky., has been incorporated, among the incorporators being James R. Nash, G. C. Atkinson, M. Cain, etc.

The Struthers Iron & Steel Company, Youngstown, O., are erecting a new galvanizing shop, and machinery of an improved class will be installed.

At Helena, Mont., the Keepkool Placer Mining Company has been incorporated. The incorporators are James J. Porter, F. Vollert, A. J. Craven and others.

The Norfolk Warehouse Company, of Norfolk, Va., contemplate the erection of a warehouse and compress, in which will be placed most improved machinery.

The capacity of the Derby (Conn.) cotton mill not being large enough, Robert Franklin Adams, the owner of the mill, has decided to have a large addition built.

At Chicago, Garvin & Co. has been incorporated to manufacture mechanical specialties. The incorporators are Frank H. Scott, George N. B. Lowes and Fred. Poole.

At Bangor, Me., Squire Bros. will erect a refrigerating plant. A tract of land has been purchased, and it is probable that building will be commenced about August 1st.

At Austin, Tex., the Huntington Automatic Railway Car Coupler Company, of Weatherford, Tex., has been chartered. Incorporators: George P. Levy, Ed. H. Lysaght, etc.

The Ontario Match Machine Company, of Oswego, N. Y., has been incorporated. Directors: W. M. Patterson, of Stroudsburg, Pa.; George O. Seward, of Trenton, N. J., etc.

The J. P. Lovell Arms Company will proceed to work at once on the erection of the new addition to the works at South Portland, Me. The building, which will correspond with those already erected, will be 150 x 50 feet in size and three storied. The building will be completed in the autumn.

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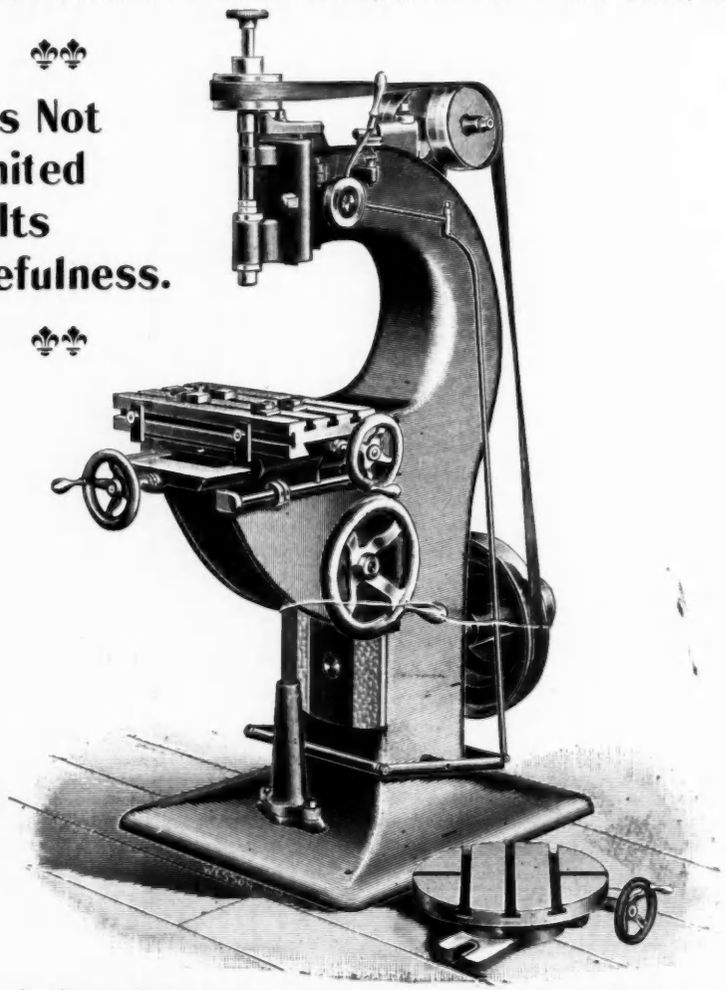

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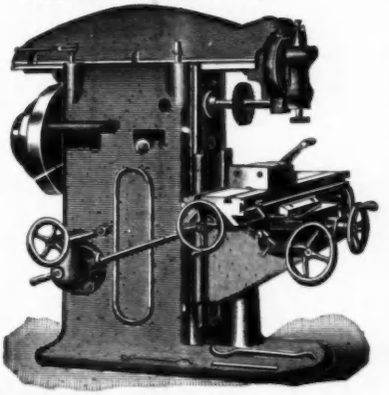

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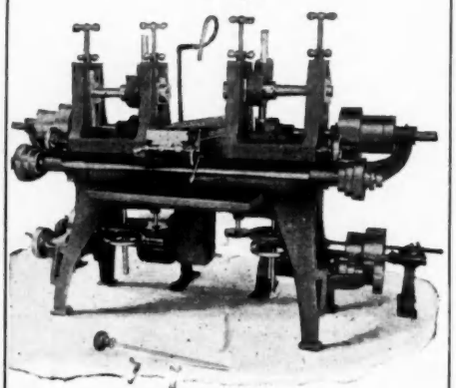

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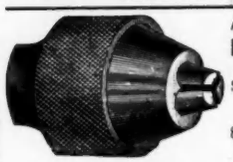
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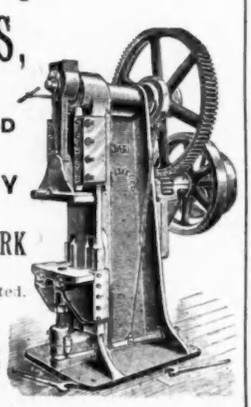
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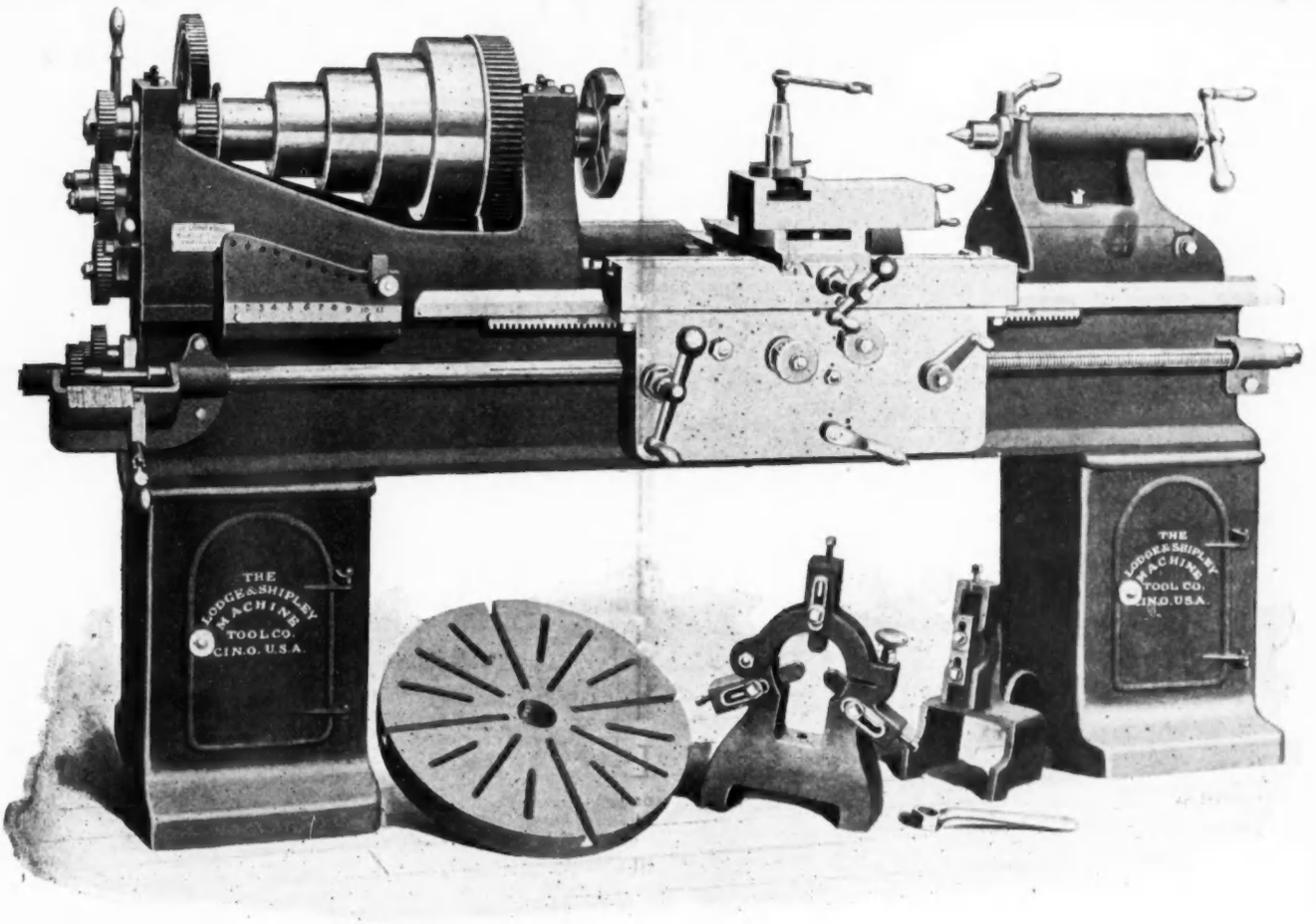

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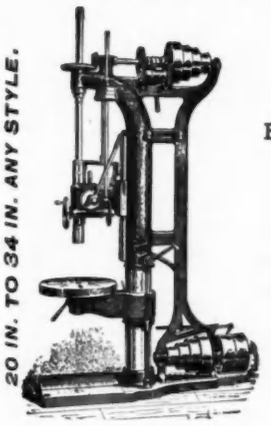

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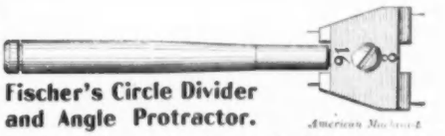

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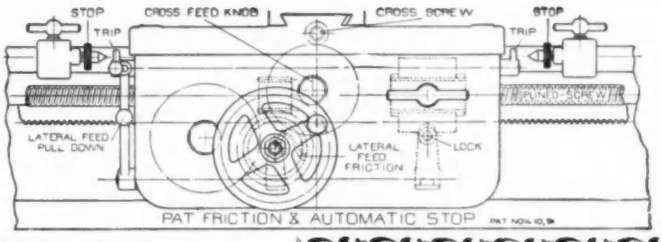

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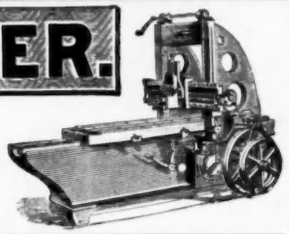

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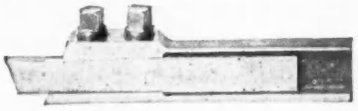

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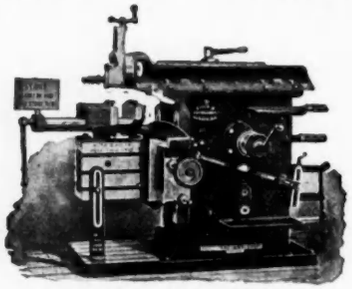

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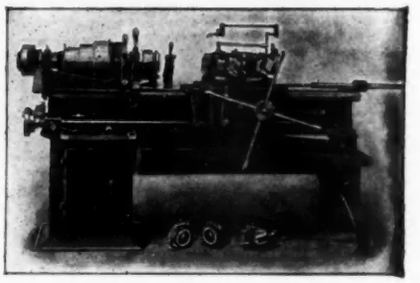

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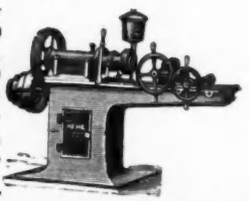

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